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ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

A Court of Patent Appeals. The adjudication of patent suits is a question of vital interest to the inventors of the country, and for this reason the bill recently introduced in Congress by Senator Platt, of Connecticut, to establish a court of patent appeals, and for other purposes, will come in for warm support from American inventors. The bill provides for the creation of a court of patent appeals, to consist of a chief justice and four associate justices, and which shall be a court of record with original and appellate jurisdiction. It shall hold a term annually in the city of Washington and shall exercise original jurisdiction in suits in equity brought by patentees, their assigns, or legal representatives against the United States for infringement of any letters patent, where the cause of action accrues less than six years prior to the filing of the bill of complaint. It may also exercise appellate jurisdiction to review by appeal or writ of error final decisions in the circuit courts of the United States, the territorial or other courts of first instance having jurisdiction of patent or copyright causes, and the Supreme Court of the District of Columbia in all cases involving the validity or infringement of or the title to any letters patent of the United States for any invention or discovery, in all suits brought by the United States seeking the cancellation of any letters patent for any invention or discovery. The decisions of this court in any case within its jurisdiction shall be final.

It is also provided that an appeal may be taken from the ultimate tribunal of the Patent Office as now existing, to the court of patent appeals under such rules as the court may establish, in any ex-parte case in which the final decision of such tribunal refuses to issue letters patent to the appellant for the supposed invention or discovery defined in the claims annexed to his specification, or in any of them; or in any interference case in which the final decision of such tribunal awards priority to another than the appellant; or in any interference case where such final decision awards priority to the appellant, but refuses to issue to him letters patent for his invention or discovery as defined in the interference issue or issues or any of them. There are various other provisions in the bill regarding the procedure before the court.

It is a well-known fact that there is a crying need for a court of this character and in the interest of the inventors of the country it is to be hoped that Congress will enact the necessary legislation to bring it into existence.

* * *

Cold Cars. The question as to whether a street railway or other common carrier is violating a provision of the Penal Code if it fails to heat its cars is likely to be examined into as a result of a cold said to have been contracted by Magistrate Flammer in one of the cars of the Manhattan Railroad Company.

The Magistrate claims that the early morning trains on the elevated road are not heated and that such a failure "annoys, injures or endangers the comfort, repose, health, or safety of a considerable number of persons," etc.

The Manhattan elevated road is by no means the only one in this vicinity that subjects its passengers to discomfort and in some cases suffering by a failure to provide heat in extreme cold weather.

A person heavily dressed keeps the blood in circulation by walking, then enters a cold car and sits possibly half to

three-quarters of an hour. The blood is no longer circulating as it should and as a result the feet become cold if not numb. An attack of cold or grippe is frequently the result.

Almost every one who has been forced to travel on the elevated and surface lines in this city has experienced at some time or other this danger and discomfort due to cold cars and if Magistrate Flammer can bring about a better condition of affairs by means of the Penal Code or any other means he will receive the thanks of a large number of the citizens of this metropolis.

* * *

Mechanical Stoking in Power Stations. The several forms of mechanical stoking appliances, according to our London correspondent, continue to find their way into electric generating stations in England notwithstanding the view which is occasionally expressed by engineers of some eminence that there is nothing to beat good hand firing. Among those who in the course of the practical operation of their plants have had actual experience with such appliances there is necessarily a great diversity of opinion respecting the comparative merits of the various types, and if we mention the view of one leading central station official, Mr. Albert Gay of the Islington Municipal Electricity Works, we think we shall represent the half-convinced attitude assumed by a good proportion of his fellow workers in central station practice. Generally speaking, Mr. Gay, after making his own tests of rival methods, expresses his ability to appreciate the improved economy of mechanical over hand firing, but beyond that he does not care to go, not being at present satisfied in regard to reliability and cost of up-keep.

As the outcome of his tests of hand and mechanical firing, he prepared some tables, and these indicated, among other things, that with coal having a calorific value of 12,000 to 13,000 B.TH.U. per lb., fired mechanically, the result was nearly equal to coal hand fired, having a calorific value of 14,000 to 14,500 B.TH.U., and that by using a lower grade coal than could be economically fired by hand, a saving of from $1.50 to $1.75 per ton might be effected.

The importance of obtaining the most perfect combustion in order to get the best results from the coal burned, a point which has been pressed home with much persistence by Mr. W. H. Booth and other leading English steam engineers, is discussed by Mr. Gay in a Society of Engineers' paper, and he places it as th chief direction in which the more economical utilization of energy in general, and electrical energy in particular, may be looked for. In this matter, however, he clearly showed that it was quite possible to get in the laboratory, under ideal conditions, such results as could not be expected in actual practice.

Mr. Gay gave descriptions of the various forms of mechanical stoking appliances, dividing them into two main types, viz., top-feed and under-feed, the former being again divided under the sub-divisions of sprinklers and cokers.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The output of 88 electric locomotives during 1903 will probably be doubled in 1904, according to resolutions adopted by some of the larger railway systems to utilize electric power, particularly for yard purposes and on those lines of road now operated by electricity.

The engineers of the Interborough Rapid Transit Company are working on the "third-rail problem," and it is expected that a report will be made soon proposing a number of plans which would be feasible by which the dangers of an exposed contact rail may be obviated. It is said that the engineers favor a plan by which the contact rail will be in short sections, which can either be "cut-out" altogether or may be automatically rendered "alive" as the trains pass along, and be "dead" at all other times.

According to a cable dispatch Sir William Ramsay is authority for the statement that a London firm of analytical chemists has thrown away for many years the by-products obtainable from pitchblende in the process of extracting uranium. It is in pitchblende that radium is now found, and these hundreds of tons of discarded refuse contained in varying quantities the element which in a fluctuating market is worth to-day at least $1,000 a grain.

At a recent meeting of the Berlin Elektrotechnischer Verein, says the *Electrician*, London, Mr. W. von Siemens described a rapid type-printing telegraph on the following principle: A disk, near the periphery of which the letters of the alphabet, figures, etc., are cut out, rotates at a speed of 2,000 revolutions per minute between a moving strip of sensitive paper and a spark-gap. Every time a spark jumps the gap, the letter on the disk which happens to be at the time opposite the gap is photographed. Two thousand letters per minute may thus be recorded on the moving tape, which passes through a developing and fixing bath, out of which it emerges after about nine seconds. To obtain good results, the spark, it is said, must occur with a punctuality of $\frac{1}{40000}$th of a second, and this has been attained by a suitable arrangement of condensers. The messages to be sent are first punched on tape, which is then rapidly run through a rotating sender by means of which corresponding current impulses in rapid succession are sent to the line.

The Automobile Club of Germany has definitely fixed upon June 17 as the date of the great race for the International Cup. The first entries show the international character of the contest, Germany, France, the United States, Great Britain, Italy, Belgium, Austria, and probably Holland and Switzerland, being represented among the competitors.

The cable ship Burnside has been ordered to proceed with Signal Corps men and equipment from Seattle, Wash., for Manila. The Philippine inter-island cables are in great need of repair, and as the Burnside is the only vessel which the Army has fitted for such work it is necessary to send her out at this time. Work on the Seattle-Alaskan cable cannot be recommenced before April on account of ice.

It is gratifying, comments the *Electrical Engineer*, London, that in the struggle going on between factories and domestic industries in some parts of Germany, the latter should occasionally have its share in the achievements of modern engineering. A co-operative enterprise with a view to supplying the domestic weavers (of the silk ribbon trade) in the Southern Black Forest with electric power has lately been started in the Hotzenwald district, it being contemplated to drive by electricity the looms of 500 weavers living in 28 different localities. The first cost of the whole of the power plant is estimated at about $85,000, this sum to be supplied by the Wald-Elektra Sackingen-Waldshut Power Company, apart from a grant by the Government. The significance of this enterprise is its enabling the above branch of textile industry to be preserved as a house industry, securing a yearly income of about $75,000 to the poor inhabitants of that part of the forest.

THE TWO-PHASE POWER TRANSMISSION PLANT AT CHRISTIANIA, NORWAY.

BY FRANK C. PERKINS.

The hydro-electric power transmission plant for supplying current for light, railway and power purposes at Christiania, Norway, is one of the most interesting and unique installations in that country. Two systems were considered for the transmission of power from Skjnerscelven to Christiania, both of which were proposed by prominent Swiss engineers. The one which was adapted was the two-phase alternating current system for generation and transmission by an overhead pole line and underground cables a distance of about 10 km. A receiving transformer station was included for distributing the current, equipped with motor-generators, boosters and storage batteries for supplying the necessary direct current for railway and low tension lighting work.

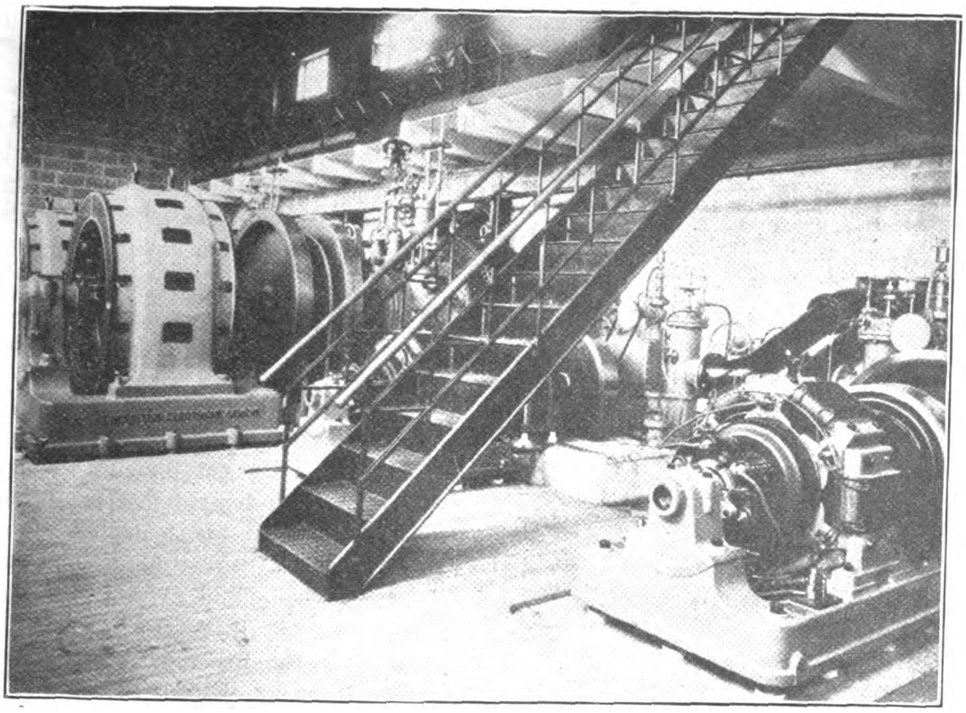


Fig. 1.—Power Station at Skjnerscelven Norway.

The other system proposed was the series direct current system of M. Thury of Geneva, Switzerland, for the generation and transmission and the use of constant current direct current motor-generators at the receiving station. An installation has been in operation for some time at St. Maurice using the direct current generators of this type, a constant current of 150 amperes being used with a potential of 22,500 volts for the power transmission line to Lausanne, which is 56 km. from the generating station. At the receiving station the continuous current is changed to a triphase alternating current for distribution by using constant current direct current Thury motors directly coupled to polyphase alternators generating a 50 cycle three-phase alternating current at a potential of 3,000 volts for distribution. This is a direct reversal of the usual methods of transmission of power as illustrated by the plant at Christiania, which is herewith decribed.

The power station shown in the accompanying illustration, Fig. 1, is located at Skjnerscelven and is equipped with six turbines direct connected to electrical generators by insulating flexible elastic couplings. There is a discharge of 2.5 cubic meters of water per second, the available head being about 100 meters. Four of the turbines have a capacity of 600 hp. each, and operate at a speed of 350 revolutions per minute. These turbines are of the horizontal type constructed by J. & A. Jensen & Dahl of Christiania.

The four 600 hp. turbines drive four Thury bi-phase alternators, which supply a current of 5,000 volts pressure and a frequency of 46.66 cycles per second. The peripheral speed is 27 meters per second at 350 revolutions per minute.

The exciters seen in the view of the interior of power house, Fig. 1, consist of two turbine-driven direct current dynamos of the Thury six-pole type each having a capacity of 50 kw. The excitation current is 17.3 amperes.

The transmission line, pole line construction and terminal station where the conductors pass underground may be noted in the accompanying illustration, Fig. 2. Two of the conductors of the overhead line have each a diameter of 8.2 mm. and the remaining ones are 6.9 mm. in diameter. The aerial line is about 8 km. long and the underground line 1.5 km. The underground cables consist of copper conductors 60 square mm. in cross section and 85 square mm. in cross section.

The receiving station at Christiania, 10 km. from the power plant, is equipped with four motor generators, which change the two-phase alternating current at 5,000 volts per phase to a direct current of 580 volts and 550 amperes for traction purposes. The interior of this sub-station is seen in Fig. 3. There is another sub-station about 1,500 meters away. A booster

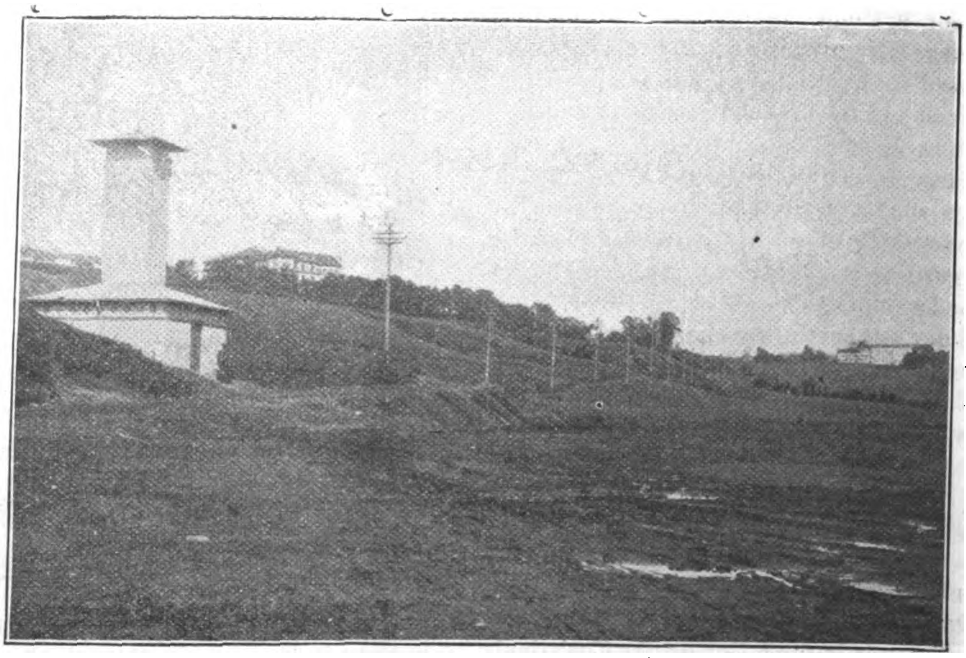


Fig. 2.—Power Transmission Lines, 10 km. Long, from Skjnerscelven to Christiania, Norway.

set is provided for raising the tension for charging the storage batteries used for the railway regulation.

The motor of this set operates at 48.5 amperes and 580 volts and the booster generator coupled to it supplies a continuous current of 500 amperes at a pressure of 55 volts. Mr. Thury has designed an automatic controller for booster sets, which is of more than passing interest. When charging the booster supplies the increased pressure which is necessary to bring the pressure of the storage cells to about 2.7 volts each. During the discharge the voltage of the batteries is raised so that a constant potential is maintained and the automatic controller makes the necessary changes from charge to discharge and vice versa without any attention whatever. All of the variations of potential are quickly corrected without regard to the output or the condition of the battery as charge or discharge. The Thury automatic regulator acts through the excitation of the boosting generator of the motor-generator set. It is operated by a small motor, a mechanical action being used without relays of any kind. A pawl and ratchet are employed which are acted upon by a solenoid and may be made as sensitive as desired. The regulation is ordinarily about 1 per cent. or ½ per cent. above or below normal.

There is in operation at the Christiania station a motor-generator or rotary converter having two fields and two armature windings which is well worth mentioning. This set is used for transforming the direct current used on the railway circuits from 580 volts to 250 volts for use in connection with a steam driven plant when desired. This outfit may also be used for supplying a 580 volt current for the traction work from the 250 volt mains in case there is an accident of any kind on the power transmission line from Skjnerselven or anything the matter with the generating apparatus at that place.

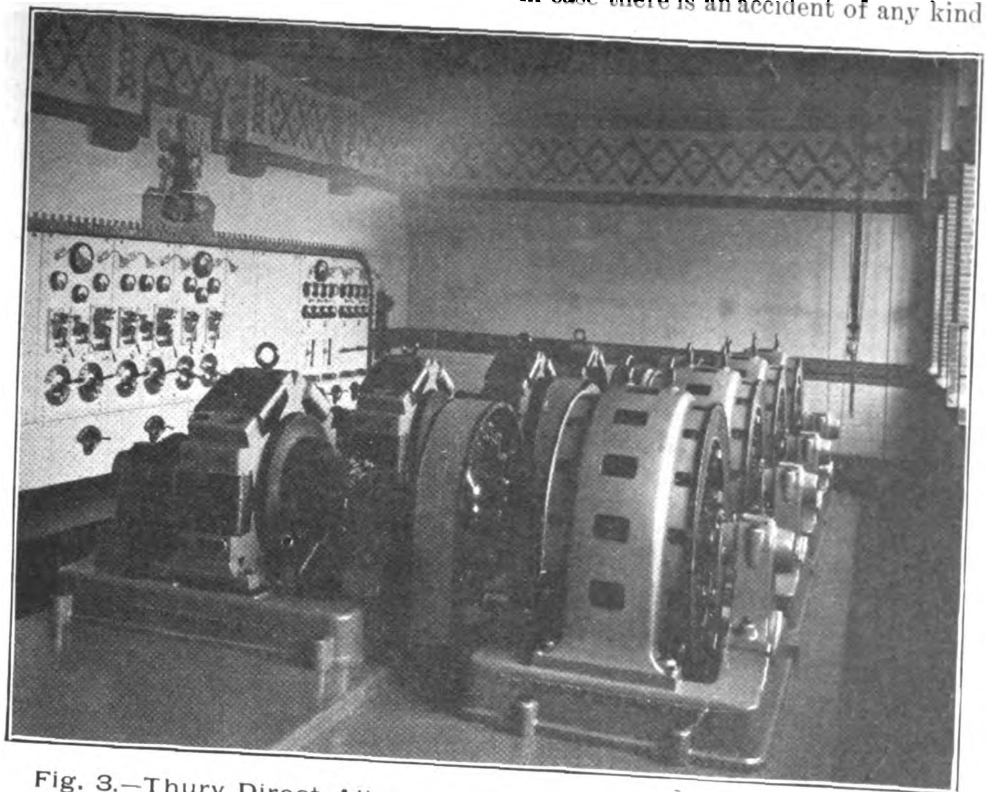


Fig. 3.—Thury Direct-Alternating Current Receiving Sub-station.

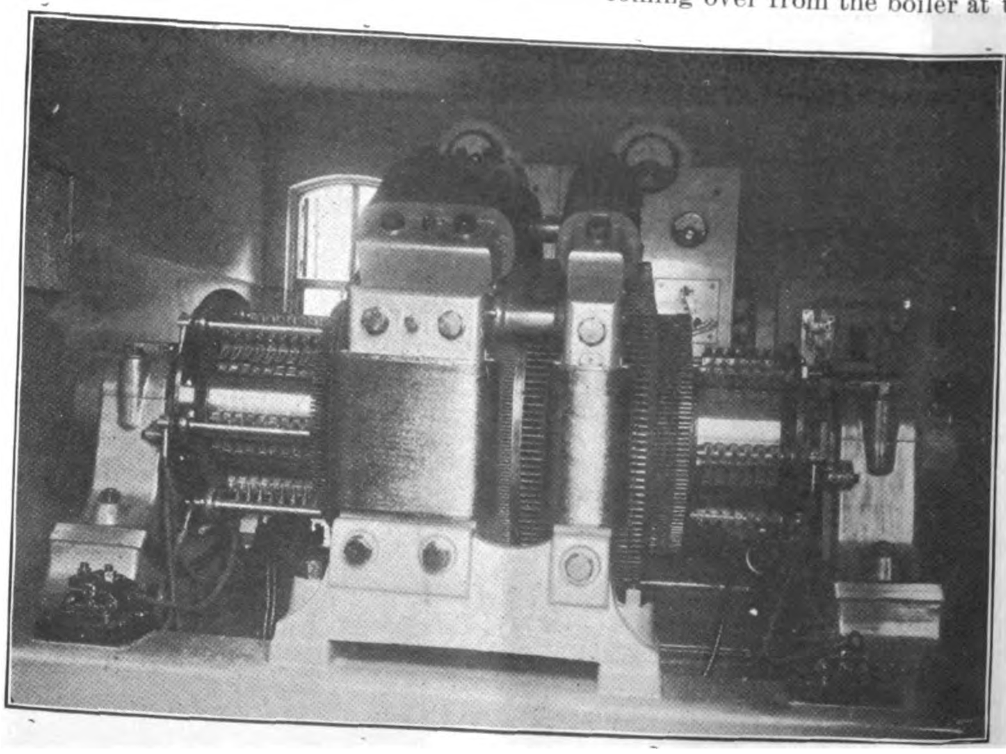


Fig. 4.—Sub-Station at Christiania, Norway.

This machine was built by the Compagnie de L'Industrie Electrique of Geneva, Switzerland, and is of somewhat peculiar construction. The armature and completed machine in operation may be seen in Fig. 4. It is a 400 kw. set with two windings on the armature, supplying a continuous current of 250 volts from one commutator and receiving a direct current of 580 volts at the other commutator, or vice versa.

WHEN AN ENGINE BECOMES A PUMP.

BY W. H. WAKEMAN.

Inasmuch as some engineers seem to think that it is impossible to convert an engine into a pump, under conditions that are ever found in practice, while others are quite sure that it can be done (some of them knowing from experience), a review of conditions which make it possible will be of interest.

When we remember that an engine is made to use steam and not water, and consider that while the former is elastic, the latter is not compressible, for all practical purposes, it is not difficult to understand that much damage may result from substituting water for steam.

For our first illustration suppose that Fig. 1 is the cylinder of an ordinary simple engine, the piston of which is traveling in the direction indicated by the arrow. It is not claimed that this engine will become a pump while carrying a load, neither are we to consider the effects of water coming over from the boiler at this time, as that is another matter to be mentioned later, but I expect to show that it is possible for it to draw in water from the exhaust pipe, and thus cause trouble.

On the engine shown in the cut, the

throttle valve is closed and the momentum of the fly-wheel causes the piston to travel back and forth for about two minutes, as this is possible in practice. Steam remaining in the steam chest and cylinder is soon disposed of, after which the advance of the piston, as shown in the cut, causes a partial vacuum to be formed in the cylinder.

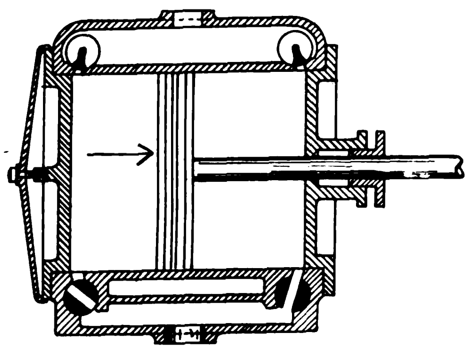


FIG. 1.

The steam valve is now closed, therefore nothing can come in from the steam chest to break this vacuum, and even if said valve was open, nothing could come in as the throttle valve is closed.

The exhaust valve must be closed during the forward stroke of engine, and under ordinary working conditions it will be, as shown in the cut, but after steam is shut off, conditions are changed. As the piston is propelled by the fly-wheel, forming a partial vacuum as before mentioned, outside pressure tends to lift this exhaust valve, but if made as shown it cannot be raised. When an engineer has charge of

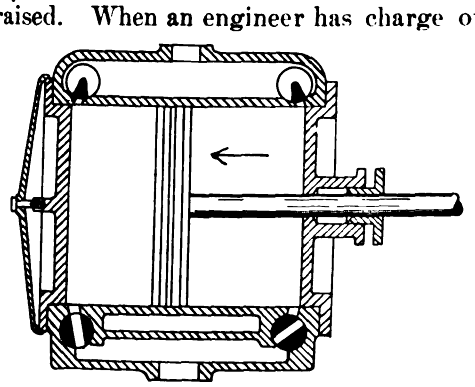


FIG. 2.

such an engine it is not difficult to make him believe that water cannot be drawn into the cylinder, but there are thousands of engines in use in which the exhaust valves can be raised from their seats, and some of them are of the Corliss type too.

Under this condition the exhaust valve will open and if there is water in the exhaust pipe it will be drawn into the cylinder by the pumping action of the piston.

If asked to explain how water can get into the exhaust pipe, the engineer can show that if the heater is not well drained it is quite possible for water to collect there, and be available for trouble making under the described conditions, as demonstrated in my own case some time ago. There are other ways in which water may be present where not wanted, but it is sufficient for our purpose at this time to know that it is found in the exhaust pipe when not wanted.

Assuming that the exhaust valve does e n (ar.d it certainly does in some cases) and that water rushes into the cylinder, let us note the effect.

The piston passes on, reaches the end of its stroke, stops, starts again and makes the return stroke as shown in Fig 2. The piston is now pushing water before it and as the exhaust valve is open there seems to be no reason why it should not pass out of the exhaust port and do no harm, but the piston travels very rapidly at this point, and after it has advanced but a trifle further the exhaust valve will be closed, thus shutting the only exit for the water. As the piston continues to advance its speed is reduced. Before it reaches the end of stroke the entire space between the piston and the cylinder head is filled with the water mentioned. It is claimed that under these conditions the steam valve will open and let the water flow into the steam chest. This may be done in some cases, but not always, for some steam valves are designed so tha they cannot be readily lifted, and others will not lift at all.

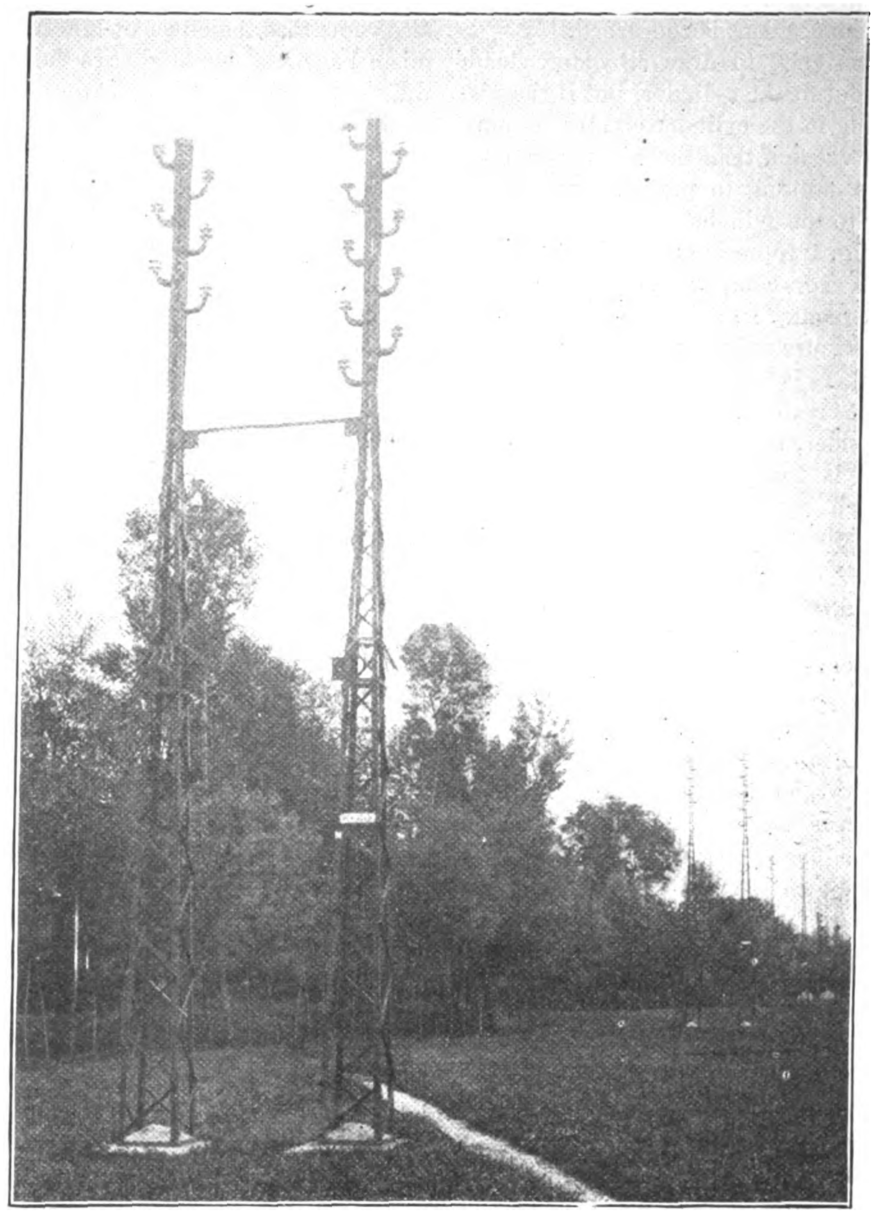


Fig. 5.—Thury High Tension Alternating Current Power Transmission Line at Christiania, Norway.

A short consideration of the matter will show that the crank is near the center at this time, therefore it has what is called a "toggle action," thus bringing very great leverage to bear on the piston, consequently the cylinder head ts blown off or some of the other parts badly bent or broken.

Again referring to Fig. 1, let us suppose that it represents the low pressure

piston of a cross compound condensing engine with an independent condensing apparatus of the jet condenser type.

In this case the exhaust pipe closely resembles the suction pipe of a pump, as it is in direct connection with a plentiful supply of cold water. The air pump is between the cylinder and the water, but it is quite possible to operate this so that it will be practically useless so far as preventing an accident is concerned.

It is designed to draw all water, steam and air out of the cylinder, but if the piston acting in the cylinder creates a more perfect vacuum than the air pump does there is nothing to prevent water from flowing to the cylinder.

As Fig. 1 represents the low pressure side of a cross compound engine it may be, and frequently is, driven entirely by the high pressure piston when starting up, hence there is a good chance for the large piston to create a high degree of vacuum in the cylinder, because on such engines the receiver is frequently large, thus presenting much condensing surface which disposes of the first steam exhausted from the high pressure cylinder before it can reach the low pressure.

A fine engine was wrecked in this vicinity some time ago in just this way, showing that it is a condition which confronts us as well as a theory. Water was drawn into the low pressure cylinder as above described, then when the return stroke was made as illustrated in Fig. 2, after the piston had advanced beyond the point shown, the exhaust valve closed, trapping the water, the piston was propelled by the momentum of the fly-wheel, also by steam pressure acting on the high pressure piston and the low pressure cylinder was broken.

A certain engine of this type, using salt water for condensing purposes, was wrecked in a very similar way, but it was done when shutting down. The engineer closed the throttle valve, either stopped the air pump or allowed it to run slowly, and did not shut off the condensing water. This combination of circumstances made it practically impossible to avoid disaster, for after the throttle valve was closed not only did the pump action of low pressure piston take place, as above mentioned, but the cylinder, receiver and exhaust pipe were filled with steam which immediately began to condense in accordance with natural laws, thus creating a vacuum of high degree, or, in other words, reducing the absolute pressure in these parts until it was much exceeded by atmospheric pressure acting on the surface of the salt water, and as a natural consequence it was forced into the low pressure cylinder.

The engineer claimed that this could not be, and was not done, but when the large cylinder was taken out, unmistakable signs of salt water were found in it, and this evidence could not be successfully disputed.

Due consideration of the above statements will show that it is quite possible to turn an engine into a pump. It will also show that the effect of ignorance and mismanagement is not always the same on different engines, although the mistakes made may be alike, because some of the parts may operate as relief valves, and thus prevent trouble.

While writing on this subject, I wish to make a few statements concerning the idea that a simple engine pumps water out of the boiler under certain conditions, thus lowering the water level rapidly, and causing trouble in the engine. A boiler may foam, or prime, and thus send water over into the cylinder. When the engine is stopped this action will cease as a natural result. This does not prove that the engine pumps it over, but on the contrary it demonstrates that the conditions which caused the boiler to prime or foam have been removed, hence the effect has disappeared.

An engine cannot pump water out of a boiler unless the steam pipe extends down below the water line, as this is a necessary condition which cannot be dispensed with under any circumstances.

Furthermore, if an engine is to pump water in this way, it must be driven by some other power, for water cannot furnish power to raise itself and drive the engine too. Taking all of these things into consideration the expression often used by engineers, to the effect that "she pumps water out of the boiler," conveys a mistaken idea, therefore it should be discarded.

SAFEGUARDS AND REGULATIONS IN OPERATION OF OVERHEAD DISTRIBUTING SYSTEM.*

BY W. C. L. EGLIN.

The distributing system can be considered as one of the integral portions of a power plant and it should receive as careful attention as either the steam plant, hydraulic plant or the electrical plant in the generating station or sub-station. In fact it would appear that the transmission system has to meet more severe conditions than any other part of the entire plant, so that the safety and reliability of the service depends largely upon the amount of forethought given to the plans and to the selection of material.

When it is considered that an overhead distributing system is subjected to many varied conditions, such as the weather, extreme changes of temperature, extraordinary storms, interference from other lines, interference by building operations, excavations, fires and other casualties, and sometimes a willful interference by the public (not to overlook the small boy with a stone), it should be readily appreciated that all these varying conditions must be considered in the construction of the line. There are two divisions of conditions: First, the mechanical or structural features, and secondly, the electrical features.

The first group will include the study of the territory in which the line is to be run, width of streets, kind of buildings, height of buildings; other distributing systems, possibilities of interference with these systems; amount of power to be transmitted, and whether the system consists of a simple power transmission circuit, or one complicated with distributing mains covering the larger part of the territory occupied by the transmission system.

Also to be considered are the weather conditions: wind-storms, rain-storms, sleet-storms, snow-storms, lightning-storms and changes in temperature from summer to winter. The method of erecting the conductors so that they can be properly repaired or additions made without endangering the lives of the men engaged in this work must be carefully planned. Unless these various points are all considered for the construction of the lines no rules or safeguards for their operation will be of material benefit.

The second group includes the electrical requirements: the conductors, the insulating method of support, and the means provided for taking care of any undue disturbances due to lightning or other causes on the line, such as lightning-arresters, fuses, switches, etc.

SPECIFICATIONS FOR MATERIAL TO BE USED.

All of the material entering into the construction of a transmission system should be ordered under specifications which shall clearly set forth the character of the material to be used and also that all of the material will be inspected before it is used on the work, and that tests will be made of samples of all material furnished. The more general requirements are as follows:

Poles.—Poles should be as short as possible to meet the conditions and preferably made of good sound chestnut.

*Paper read at the 182d meeting of the American Institute of Electrical Engineers, New York, December 18, 1903.

Southern cedar and pine poles are sometimes used when chestnut is not obtainable. It may also be necessary to use iron poles under certain conditions; but iron poles are to be avoided, principally on account of danger to linemen and also to the short life of the pole, due to rusting. The pole should be roofed at the top to form a right angle, and gained to form a flat of about 5 inches for the attachment of the cross-arms.

All poles, upon which are located devices requiring regular inspection, should be provided with steps in order to facilitate this work. Spacing of the poles should be carefully considered and should not exceed from 40 to 45 yards. End and corner poles should be braced, and at least every tenth pole throughout the line should be guyed with ¼-inch or ⅜-inch stranded galvanized wire. Regular inspections, at least annually, should be made of the condition of the poles, which is most readily determined by examination at the base of the pole. When poles are used as junction-boxes, that is, when lines are run at right angles and attached to the same pole, special care is necessary. A separate drawing should be made of all such poles, showing the arrangement of the wires—keeping in mind the simplest possible arrangement—as a protection for the men who climb these poles. Switch-boxes, fuses, lightning-arresters or transformers should not be attached to such poles but on the first pole removed from this junction-pole. Junction-poles can frequently be avoided by the use of two poles making a "Y" connection of the line. By this arrangement the connections are very materially simplified.

Cross-arms.—Cross-arms should be spaced at least 24 inches between centers, the top of the first arm being one foot from the top of the pole.

Braces.—Braces should be made of galvanized iron not less than 1¼ inches by $\frac{3}{16}$ inch thick and about 28 inches long.

Pins.—The pins should be made of locust wood well-boiled in linseed oil, and are preferable for voltages of 5,000 volts and under. For high voltages, pins should receive special consideration.

Insulators.—The insulator on the pole line fulfills two functions, viz: The mechanical support of the line, and the insulation. As these conditions vary over a wide range, they must be considered for each condition. This is especially so for voltages of 10,000 volts and over. The two materials of which insulators are usually made are glass and porcelain. The glass insulator is more uniform in quality of material than the porcelain, so that for lower voltages glass insulators are recommended. For higher voltages, porcelain insulators are preferred for the following reasons: Greater mechanical strength, better insulating qualities, and greater ability to withstand severe weather conditions.

Insulators of high voltages should be made up of a number of insulators cemented together so as to obtain more uniform insulation and to increase the factor of safety from defective manufacture. Before being used, each insulator for high-tension work should be tested at voltages in excess of the operating voltage.

The method of attaching the conductor to the insulator should be carefully considered; first, to see that the wires can be properly fastened to the insulator, and secondly, to see that the strain is transmitted without a twisting or bending strain in the insulator; the only strain permitted should be in compression.

The method of distributing the wires on the pole lines depends on the number and character of the various circuits to be installed. For all voltages below 6,000 volts, the wire should be brought out of the station through long porcelain tubes, properly supported; the various circuits being grouped together but well spaced, and preferably being distributed in a single, or not more than a double row of wires. This fan effect allows the circuit to be distributed to the poles without any undue bunching, thus making each circuit easily distinguishable.

The top gain of all poles should be left vacant so that guard-wires can be placed at any point on the line, should they be required. The transmission circuits which are alive 24 hours per day should be placed on the top arm; that is, the trunk lines should occupy the position where there will be the least liability of coming into contact with the other wires or with the men working on the poles. All other circuits should be placed below series arc circuits occupying the lower arms, the distributing series circuit being placed on the house of the lower arms on outer pin occupied by such circuits. The bottom cross-arm should be used for such secondary circuits or low-tension lines as may be required. Space should always be provided for an extra arm on the pole for the erection of a transformer. Protective devices for each circuit may be classified as follows: Circuit-breaker, fuses for branch circuits, and lightning-arresters. Also indicating instruments as follows: Voltmeter, ammeter or wattmeter, and ground detectors.

In the arrangement of the protective devices it is desirable to locate as many of these as possible in the station or sub-station, for the reason that they are more readily inspected and kept in perfect working order, which insures the fulfilling of their functions when required. All circuits of 200 kw. capacity or over should be protected by means of oil circuit-breakers in preference to fuses, to all voltages over 1,000 volts. These circuit-breakers should be attached to both ends of the line, when two or more feeders are used and connected to the same bus; and there should be no other circuit-breaker or fuses which are automatic in action placed at any other part of the line. Small branch circuits may be taken care of when necessary by fuse boxes placed upon the first pole of the branch circuit. These fuse boxes, however, should be avoided whenever possible. This can be accomplished by making a branch circuit about the same as the main circuit, depending entirely upon the circuit-breaker in the station to protect both lines. When small branch circuits are desired, place such fuse boxes. These preferably should be an inclosed fuse of the cartridge type mounted on a porcelain base, the whole inclosed in a fireproof and waterproof compartment. This is usually an iron box with a cover and rubber gasket, clamped so as to make it water-tight.

Lightning Arresters.—Lightning arresters should be installed at both ends of the line, in the station and sub-station, on each conductor. Special care should be used in their installation, and provision made that in the event of a breakdown of the lightning arrester, current may be interrupted by means of a circuit-breaking device.

Series Arc Loop Cut-outs.—These should consist of a mechanically operated switch which closes the circuit at the point of the loop and disconnects the loop from the main line. For the use of constant-potential circuits there may be either a fuse-box provided with solid catches or fuses, depending on the conditions, all of these devices being inclosed in fire and waterproof cases.

Before considering the actions of the safety devices it is necessary, first, to examine the faults which may develop and the functions which the safety devices are required to fulfill. If the condition of a wire parting is first considered, we have first the liability of the wire coming in contact with some of the other circuits; secondly, its liability to fall into the street, and thirdly, its remaining suspended clear of all circuits and the ground.

The first condition, the effect of coming in contact with other wires, would immediately raise the voltage to the more powerful of the two circuits, so it is evident that the insulation of the other circuit must either be as good or there will be a liability of the insulation breaking down at some point on the weaker circuit. This will first be detected at the station by showing that the load is dropped from this circuit, and it demonstrates that the insulation of all circuits must be the same when placed on the same pole-line, unless means are provided for taking off extraordinary high voltages. This can be done by placing spark-gaps, which will relieve the high-tension from any low-tension circuits, or by grounding a wire on the lower-tension circuits.

Wires falling on the ground will indicate immediately in the station, on the ground detector, that there is a ground on that circuit, and instructions should be given that as soon as a ground shows on the circuit and the circuit is not carrying the load to disconnect it.

The third condition will indicate in the station that the load is dropped and will not show a ground. The circuit should be cut off in this case also and inspectors sent out to look after the trouble.

Fourthly, if a wire breaks and falls, crossing other wires of the same circuit, this will cause a rush of current on constant-potential circuit and immediately open the circuit-breaker. In the series arc-circuit it will cut out a portion of the circuit which will be indicated on the voltmeter, showing the necessity of regular voltmeter readings on such circuits.

Interference With Other Wires Falling or Coming in Contact With the Power Circuits.—If these wires cross the power circuit and drop loosely on them, the effect will be to short-circuit the power circuit on constant-potential circuits; the defect develops immediately. The wires either burn off or an arc may be established which will burn off the power circuit, breaking the wires and the connection. The provision should be as the conditions shown for the breaking of a wire. A single wire may merely come in contact with one wire of a constant-potential circuit and assume the same voltage as that circuit; there will be no way of determining this at either the station or the sub-station, unless that wire was grounded and the ground indicated on the ground-detectors. In the event of this falling wire coming in contact with both sides of the series arc-circuit, a portion of the circuit will be cut out and indicated on the voltmeter at the station. Should it come in contact with only one wire of the circuit, no indication will be made at the station unless the wire be grounded. For this reason inspection should be made and all such wires changed so as to come below the power-circuit and not above it. This also demonstrates the necessity of placing protective devices on foreign wires which may come in contact with power circuits.

Lightning Storms.—The installing of efficient lightning arresters as specified may protect the apparatus at both the generating station and sub-station, but fail to protect apparatus at intervening points, particularly the transformers. It is possible that lightning may jump from primary to secondary of transformers during a severe storm. This would be indicated by the primary fuse blowing in the transformer; and after the blowing of the fuse from this cause, tests should be made of the transformer as follows.

It is essential that when a primary fuse on a transformer is blown through any cause, the secondaries should be disconnected from the transformer, and the latter tested to full-line voltage between the primary and secondary coils, so as to determine that there is no breakdown in the insulation between these coils.

There are two methods by which these tests may be readily made by the linemen without removing the transformer: First, take from the station a 600-watt transformer, connect its primary for the line voltage and its secondaries for 100 watts, and connect a 50-volt lamp across the latter. Attach one primary lead of this test transformer to one secondary wire of the line transformer, and place one-ampere fuses in the primary cut-outs protecting the line transformer. Now connect the other primary lead of the test transformer, first to one and then to the other of the main primary lines. If the 50-volt lamp filament becomes red, the line transformer is defective, and should be returned to the station. Second method: If impossible to use the first method, proceed as follows: Attach a short piece of heavily-insulated rubber wire to one of the secondary wires leading from the transformer. Then place one-ampere fuses in the cut-outs, and connect the specially insulated rubber wire first to one and then the other of the main

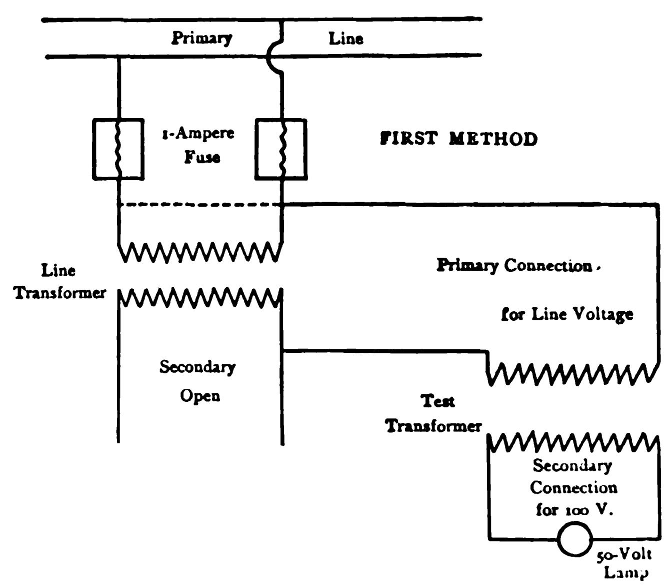


Fig. 1.

primary lines. If the fuse blows, or a spark shows when contact is made, the transformer is defective and should be removed from the line.

In the event of lightning arresters being placed on the pole line, all such lightning arresters should be inspected after each heavy lightning-storm.

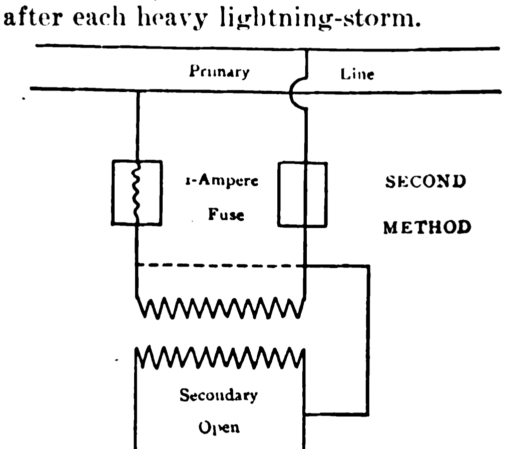


Fig. 2.

Transformers.—Transformers when supported on the poles should be hung on an extra cross-arm provided for that purpose. The primary leads from the line to the fuse-box and to the transformer should be insulated with rubber-covered braid for the line voltage. Transformers should not be attached to buildings or in such locations as to be handled by unauthorized

people, and when they are placed in buildings they should be put in a separate fire-proof closet or room which is controlled only by the operating plant. As it is now the general practice to use oil-transformers it is unnecessary to consider dry-transformers. Inspection should be made to see that the cases are properly filled with oil. This should be done by an inspection force, and not by the men erecting the transformers.

Inspection.—The greatest safeguard in a transmission line is regular inspection. Lines can with advantage be inspected daily, not only an inspection from the ground, but a regular monthly inspection of all devices attached to the line when a continued service is desired.

In may be necessary on some parts of the line to introduce cable. This should be avoided whenever possible for the reason that the conductors are brought close together at this point and static discharge is liable to puncture the insulation; so means should be provided at both ends of the cable to take care of the static. This is best arranged for by a series of gaps of the lightning-arrester type. Standard lightning-arresters can usually be used for this purpose. They should, however, be provided with a small fuse in series with the connection to the line so as to prevent short-circuiting the lines in case of failure of the spark-gaps.

ELECTRICAL STATION PRACTICE.

ARTICLE XVIII.

BY W. H. RADCLIFFE.

The plan of switchboard wiring for alternating current work depends upon the system in use, and this latter may be either of the single-phase, two-phase, three-phase, or monocyclic types. The general principles in all these cases, however, are practically identical, so that there will first be taken up in detail the fundamental one and then in a general way the characteristics in each of the others, thereby enabling the reader to form an excellent idea of this class of work as a whole. As to the fundamental case, reference is here made to the single-phase system and in Fig. 19 a diagram showing the switchboard wiring for a single-phase alternating current generator or alternator, is presented.

In this illustration the alternator is shown at *a*, with its field winding *p* separately excited by the direct current generator *b*. As an aid in reading the diagram the conductors carrying alternating current are represented by solid lines, whereas those carring direct current are denoted by dotted lines. First let us trace out the connections for the exciter *b*. This generator is a shunt wound machine, the shunt field winding being drawn in at *q*. By means of the rheostat *f* in series with *q*, the voltage of the exciter is varied; this, in turn, varies the voltage developed in the alternator *a* since the main leads *d* and d^1 of the exciter are connected through a double-pole switch *g* to the field winding *p* of the alternator. A rheostat *e* is also introduced in this field winding to adjust the pressure of *a*. It may seem unnecessary to employ a rheostat in each of two separate field circuits to regulate the voltage of *a*, but these rheostats are not both used to produce the same result; when a considerable variation of pressure is required, the rheostat *e* is manipulated,

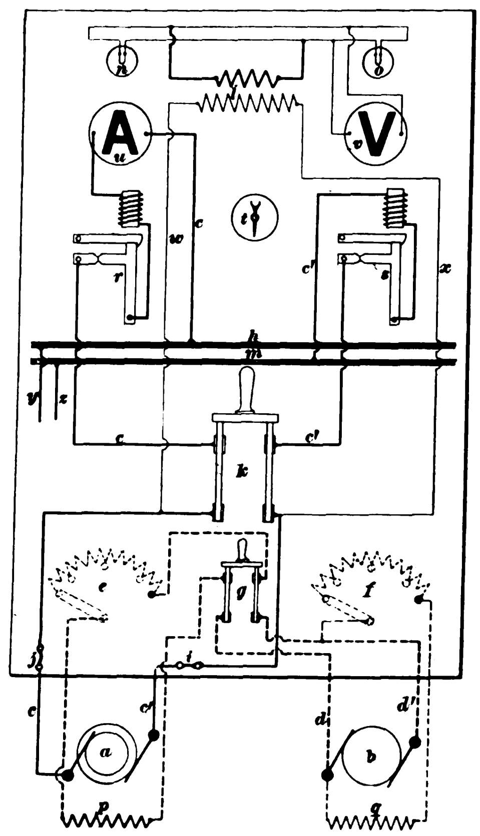


Fig. 19.

whereas for a fine adjustment of voltage the rheostat *f* is preferably employed. Sometimes a direct current ammeter is introduced in the alternator's field circuit to aid in the adjustment.

The main circuit $c\ c^1$ of alternator *a* after being protected on both sides by the fuses *j* and *i*, runs to the double-pole switch *k*. The fuses *j* and *i* serve as a protection to the alternator *a* in case of a short-circuit at the switch *k*. It will be noticed the fuses are of the single-pole type and are mounted a considerable distance apart; this is to prevent any liability of a short-circuit between them in case of action. Inclosed fuses are now used entirely for such work, since in these there is no danger of heated metal being thrown about and causing damage when the fuse wire is melted. Inclosed fuses are also more readily and quickly replaced than open fuses, the containing tube of each being easy to adjust in circuit and when the fuse wire within is once melted the tube is discarded for a new one. The circuit $c\ c^1$ after passing through the switch *k* is further protected on both sides by circuit breakers *r* and *s*. Leaving these protective devices, the left-hand side of the circuit includes the alternating current ammeter *u*, and then through the conductor *c* connects with the bus bar *h*; the right-hand side of the circuit runs from *s* to the bus bar *m* through the conductor c^1. As many feeder circuits, such as *yz*, may be connected to the bus bars *hm* and supplied with current by the alternator *a* as the capacity of this machine will permit. If, however, there be more than one feeder circuit, each one must be wired through a double-pole switch.

In alternating current work the pressures dealt with are much greater than those in direct current installations, so that proportionate care must be taken in the wiring to remove all possibility of grounds. To locate such troubles, however, should they occur, a ground detector *t* is provided. For this class of work the ground detector must be an instrument especially designed for high potential circuits. One of its terminals should be connected to the line and the other terminal to ground; in case of a leak on the line a current will then flow through the detector and by the brilliancy of a lamp connected in circuit the seriousness of the leak may be judged. A step-down transformer *l* is also rendered necessary for the voltmeter *v* and the pilot lamps *n* and *o*, owing to the high voltage in use. The primary winding of the transformer *l* consists of a large number of turns of fine wire, and this is joined by means of the wires *w* and *x* across the main circuit of the alternator, between *a* and *k*. This connection should never be made so that it will be cut out of circuit when the switch *k* is open, for it is always advisable to consult the voltmeter *v* before throwing on the load by closing this switch. The secondary winding of the transformer *l* consists of a comparatively small number of turns of large wire so that the voltage induced in this circuit will be within the limits of the voltmeter *v* and of the pilot lamps *n* and *o*.

In the two-phase alternating current system or quarter phase system, as it is frequently called, an alternator is em-

ployed which generates two alternating electromotive forces having the same maximum values and the same minimum values, but which lag the one behind the other, or in other words, differ in phase by 90 degrees. Since there are two distinctive electromotive forces or currents, these may be handled separately from the alternator on two circuits thereby requiring four wires, or the common sides of the two circuits may be joined together after passing through the switchboard apparatus requiring from there on to the lamps or motors but three wires. Inasmuch as the latter plan effects a considerable saving in copper for the line wires it is commonly employed. In either case the switchboard wiring is practically the same, and differs from that shown in Fig. 19 for the single-phase system in the introduction of an ammeter and a compensator in each of the outside wires, and in the use of a four-pole switch in place of the two-pole switch k. The ammeters, of course, are for measuring the alternating currents in each of the two phases or legs of the system, and the compensators are merely two transformers each with their primary coils in series with the outside wires and their secondary coils in series with each other across the outside wires. The transformers thus connected are known as compensators or potential regulators, and as such compensate for the drop in pressure on either side of the system. The two central terminals of the four-pole switch, which connect directly with the line wires, are joined together by a conductor, and from this point one wire is led off. This wire, together with the two outside wires, from the feeders of the system. One voltmeter will be sufficient on the board if a proper switching device in employed to shift its connections across either of the two circuits; otherwise two voltmeters will be necessary, one bridged across each of these respective circuits. The same reasoning holds true in regard to ground detectors, so that one or two of these will be required, depending upon the aforementioned conditions.

In the three-phase alternating-current system, an alternator is employed which generates three alternating electromotive forces having the same maximum values, and the same minimum values, but which lag the one behind the other, or in other words, differ in phase by 60 degrees. Since there are now three distinctive forces or currents, it is the universal practice to employ for this system three wires. The essential points of difference between the switchboard wiring for this system and that shown in Fig. 19 for the single-phase system, are therefore the use of a three-pole switch in place of the two-pole switch k; the insertion of an ammeter, a circuit breaker, and a compensator in each of the three wires of the system: the presence of two ground detectors instead of one, and the addition of a voltmeter switch if but one voltmeter be provided, or else the installation of two voltmeters connected the one between the middle wire and outer right-hand wire, and the other between the middle wire and outer left-hand wire.

The monocyclic system although of comparatively recent adoption has, owing to its simplicity and the means thereby afforded of operating both lamps and motors from the same alternator, proved itself of great value for this class of work and has therefore become extensively employed. The alternator used generates two electromotive forces which differ in phase by 90 degrees, and by means of three transmission wires these two pressures, one of which has a value of almost .56 of that of the other, are available for use. Alternating-current motors may be connected to the two outside wires and the middle wire or power wire as it is called in the same way as they would be to a three-phase system; while between the two outside wires, arc lamps or incandescent lamps may be introduced into circuit. Since the switchboard wiring for this system is the same as that for the three-wire system already described, no further explanation is necessary.

In the switchboard diagrams previously presented, no lightning arrester connections have been shown for the reason that they are in most cases mounted on the walls of the station near the place at which the line wires enter. If they are mounted outside the station at this point, special precautions should be taken to keep them free from moisture by inclosing them in iron cases, but no matter where they are located it is necessary that they be dry in order to work properly. If possible, one place should be set aside for them and a marble or slate panel provided on which they may be mounted. Wooden supports are undesirable for lightning arresters on account of the fire risk incurred; this, however, may be reduced to a minimum by employing skeleton boards and using sheets of asbestos between the arresters and the wood.

In parts of the country where lightning is of common occurrence, and where overhead circuits are installed which carry high pressures, heavy currents, and extend over considerable territory, it is advisable to have the station well equipped with lightning arresters of the most improved types. Even when lightning arresters are mounted on the switchboard, and this is often done on those wired for alternating currents, they do not present an unattractive appearance, being in one common type composed of seven cylinders of non-arcing metal placed side by side, and separated by air gaps. These cylinders are mounted on a marble base attached to the back of the switchboard near the bottom, and are knurled so as to present hundreds of points for a discharge to take place between them. The two-line wires are connected, one to each outside cylinder, and the middle cylinder is connected to ground. Owing to the air gaps between the cylinders, the alternating current will not flow along this path, but should the line be struck by lightning it will pass freely across them to the middle cylinder and so be conducted to the earth.

In each side of the circuit between the lightning arrester and the switchboard apparatus there should be connected a choking or kicking coil, or what is practically the same thing each of the main conductors may be tightly coiled up for a part of its length. A quick and effective way of coiling up a wire consists in wrapping that part of the conductor in which it is desired to have the coils around a cylindrical piece of iron or wood, the desired number of times, and then withdawing the cylindrical pieces. The coils, each of which may may contain 50 and 200 turns, thus inserted in the main circuit, introduce a high resistance or reluctance to a lightning current, and so prevent the same from passing to the generator; there will, however, be an easy path to earth afforded it through the lightning arrester, as already explained, and so no damage will be done. Coils of the nature just mentioned may advantageously be introduced between the generator and switchboard to take up the reactive current developed upon the opening of the circuit, and also wherever there are suspended conductors to take up the slack by the spring-like effect produced by the coils.

There are certain features peculiar to alternating current switchboards on account of the high potentials cared for thereon, that are worthy of mention. First of all the safety of the attendant should be considered in the design of the board by screening all the exposed terminals on the front of the same in some effective manner. Protection to the

attendant may also be afforded in another way by mounting all the switch mechanism on the back of the board with simply the switch handle projecting through to the front; by pushing or pulling the switch handle the connections may be shifted either to one side of the system or to the other. Less difficulty will attend the breaking of high pressure circuits than would be experienced if the circuits carried lower direct current potentials, because in the former case the arc established between the switch terminals is quickly ruptured by the reversals of the current. When two or more alternators are to be operated in multiple, as will be explained later, a very convenient arrangement consists in mounting the voltmeter on a swinging bracket at the side of the switchboard. The voltmeter may then be swung around in any direction, affording thereby an excellent idea of the pressure while the additional alternator is being switched in. Lastly, in regard to the conductors used in wiring for alternating currents it may be stated that, when the current is such as to require a conductor larger than ½ inch in diameter, it should be stranded. This is necessary in order to limit the drop in volts across it, as otherwise its valve would be considerably in excess of that caused by the resistance of the conductor in ohms.

Carnegie's Gift to Engineers.

Andrew Carnegie's proposal to give $1,000,000 for the erection of buildings for the Engineers' Club and the united engineering societies on West 39th and 40th streets, was, it appears, only a tentative figure, says the New York *Times*, and his actual gift is likely to be largely in excess of that sum.

A circular just prepared for distribution among members of the American Society of Mechanical Engineers tells of the visit of a special committee to Mr. Carnegie and of how he made it clear that the figure he had mentioned need not be adhered to and that the question of cost should be made secondary to the erection of a building which should be a monument to the engineering profession.

The project will be in a measure two separate enterprises, the new home of the Engineers' Club standing on the two lots at 32 and 34 West Fortieth street, and the Union Engineering Building, as the structure for the allied engineering societies, will probably be called, on the abutting property at 25 to 31 West Thirty-ninth street. Just how soon the erection of the buildings will be begun nobody seems to be in a position to state at present, but it will probably be within the next few months, and announcement of a limited competition for selecting an architect will be made shortly.

The project may be delayed somewhat owing to the failure of the American Society of Civil Engineers to signify as yet its acceptance of the plan. Final action by that organization will be taken within two or three weeks, and it was stated Monday that whatever this action is, it will not deter the other organizations from accepting Mr. Carnegie's proposal.

Proposals Invited.

The Interior Department, through the Commissioner of Indian Affairs, is inviting sealed proposals until January 21, for furnishing and delivering the necessary materials and labor required to construct and complete an electric lighting system at the Cherokee School, Cherokee, N. C., in accordance with plans, specifications and instructions to bidders, which may be obtained upon application to the Commissioner of Indian Affairs, Washington, D. C., and at the Indian Warehouse, 119 Wooster street, New York City.

Sealed bids will be received by A. A. Clapp, Sr., city clerk, Alhambra, Cal., up to 7 February 9, for a franchise to erect poles, string wires and construct underground conduits, to maintain and operate the same for 50 years, for the purpose of transmitting electricity for light, heat and power. Each sealed bid must be accompanied by cash or certified check payable to the city treasurer of Alhambra, for full amount of bid, and no bid will be considered unless cash or check is inclosed.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DECEMBER 29, 1903.

Electric Railways and Appliances.

748,268. Magnetic Contact-Box for Electric Tramways. Alfredo Diatto, Turin, Italy. Filed April 8, 1902.

748,322. Trolley Device. Ralph P. Tisch and Robert Kissinger, Hebron, O.; said Kissinger assignor to said Tisch and Charles A. Pence, same place. Filed May 23, 1903.

748,422. Trolley. Walter J. Rowley, Allegheny, Pa. Filed May 7, 1903.

748,441. Trolley. Thomas F. Varley, Lowellville, O. Filed Aug. 14, 1903.

748,557. Electrically-Controlled Railway-Switch. Frederick T. Kitt, Denver, Col. Filed March 4, 1903.

Electric Lights and Appliances.

748,121. Electric-Arc Lamp. Knut Tornberg, Medford, Mass. Filed Nov. 1, 1902.

748,148. Cut-out for Arc-Lamps. Malcolm H. Baker, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Oct. 30, 1902.

748,185. Electric-Arc Lamp for Multiple or Parallel Circuits. Robert H. Henderson, Newark, N. J., assignor to the Westinghouse Electric & Manufacturing Company. Filed March 30, 1903.

748,337-747,338. Socket for Incandescent Electric Lamps. Charles Bakeley, Covington, Ky., assignor of one-half to Chas. Akers, same place. Filed June 18, 1903.

748,445. Incandescent-Lamp Socket. Charles Wagner, Brooklyn, N. Y. Filed May 2, 1902.

Electrical Machinery and Apparatus.

747,926. Multiple-Cylinder Steam-Engine. Henry S. Baldwin, Lynn, Mass., assignor, by mesne assignments, to the General Electric Company. Filed June 1, 1903.

747,927. Exhaust-Relief for Steam-Vehicles. Augustus A. Ball, Jr., Lynn, Mass., assignor, by mesne assignments, to the General Electric Company. Filed June 8, 1903.

747,968. Electric Meter. Ludwig Gutmann, Peoria, Ill. assignor to the Sangamo Electric Company, Springfield, Ill. Filed Jan. 6, 1902.

748,053. Bar for Collecting Electricity for Sectional Circuits. Henri Dolter, Paris France. Filed Feb. 19, 1902.

748,083. Multiple-Cylinder Steam-Engine. Hermann Lemp and Otto F. Persson, Lynn, Mass., assignors, by mesne assignments, to the General Electric Company. Filed Jan. 12, 1903.

748,098. System for Controlling Fluid-Pressure. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company. Filed May 21, 1903.

748,123. Electric Switch. Isaac G. Waterman, Santa Barbara, Cal. Original application filed Feb 27, 1902. Divided and this application filed July 1, 1902.

748,145-748,147. Method of Regulating Electric Circuits. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 26-28, 1902.

748,146. Constant-Power-Factor Regulator for Electric Circuits. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 28, 1902.

748,149. Regulating Device for Electric Circuits. Malcolm H. Baker, New York City, assignor to the Westinghouse Electric & Manufacturing Company. Filed Dec. 8, 1902.

748,182. Magnetic-Power Mechanism. Frederick Hachmann, St. Paul, Minn., assignor of three-fourths to E. R. Wiswell and Benjamin F. Simon, same place. Filed May 8, 1903.

748,228. Turbine-Motor. Byron Stevens, Schoharie, N. Y. Filed July 20, 1903.

748,240. Bearing-Thermostat. George A. Wall, Providence, R. I. Filed Oct. 28, 1902.

748,323. Thermostat. George A. Wall, Providence, R. I. Filed Oct. 28, 1902.

748,354. Automatic Controller for Electric Pumps or the Like. Charles H. Durning, Swissvale, Pa. Filed Jan. 26, 1903.

748,534. Electric Generator for Intermittent Currents. Malcolm P. Ryder, White Plains, N. Y. Filed March 11, 1903.

Telephones and Telephone Apparatus.

748,397. Circuit-Changing Apparatus. William Meyer, Chicago, Ill., assignor, by mesne assignments, to the Stromberg-Carlson Telephone Manufacturing Company. Filed Oct. 10, 1901.

748,524. Telephone-Support. Charles H. Pelton and William Ramsey, Springfield, O. Filed May 29, 1902.

Miscellaneous.

747,949. Signaling System. William H. Dammond, Detroit, Mich., assignor of one fourth to Edward M. Bryant, same place. Filed Nov. 5, 1902.

748,086. Electric Firing-Gear for Breech-Loading Guns. John F. Meigs, Sigard A. S. Hammar and Leighton N. D. Mixsell, Bethlehem, Pa., assignors to the Bethlehem Steel Company, South Bethlehem, Pa. Filed Aug. 27, 1902.

748,143 Wireless Telegraphy and Transmission of Power. James T. Armstrong and Axel Orling, London, Eng. Filed March 11, 1901.

748,309. Electric Heating Pad. William Rickards, Los Angeles, Cal. Filed July 2, 1902.

748 360, Igniting Device. William Gardner, Brooklyn, N. Y. Filed Sept. 27, 1902.

748,408. Elevator Signaling Apparatus. John McLean, New York City. Filed Nov. 16, 1901.

748,442. Vibrator for Induction-Coils. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed Nov. 6, 1903.

748,450. Block-Signal System. Elmer E. Wolf and James B. Williams, Springfield, O., assignors to James B. Williams, same place. Filed June 20, 1902.

748,501-748,502. Electric Signaling Apparatus. Felix B. Herzog and Schuyler S. Wheeler, New York City; said Wheeler assignor to said Herzog. Filed Jan. 25, 1886.

THE TELEPHONE WORLD.

Iowa Independent Convention.

The Western Iowa Independent Telephone Association recently held its second annual meeting at the Grand Hotel in Council Bluffs. The principal business was a discussion of plans to secure Independent connection with Council Bluffs, the topic being: "How can we persuade the people of Council Bluffs to allow 10,000 telephone subscribers in Southwestern Iowa to talk with them?" The discussion was opened by H W. Cutshall, of Shelby, who said in part:

"When a merchant in a town tributary to Council Bluffs, takes up his telephone receiver, and calls for Council Bluffs, and is informed that there is no connection with this town, if he is in a hurry for his order, he will naturally ask for connection with Sioux City, Des Moines or some other convenient jobbing point, and Council Bluffs will thus lose much trade. Of course, many of the towns have the Bell toll stations, but this necessitates the customer running over to the booth every time he wants to call, and waiting around, sometimes for half an hour, before he gets the party. In a few of the towns the Bell Company has exchanges, but in most towns where there are both, the Independent telephones are vastly in the majority."

M. A. Reed discussed the subject, "How can we best secure the construction of long-distance copper metallic toll lines in Southwestern Iowa?" and P. C. Holdoegel, "Rules for rural lines and how to enforce them."

It was unanimously decided to call the organization the Southwestern instead of the Western Iowa Independent Telephone Association, and the officers elected for the ensuing year were as follows: President, H. A. Kinrey, Woodbine; vice-president, P. C. Holdoegel, Rockwell City; secretary, J. F. Glenn, Denison; treasurer, A. T. Whittle, Harlan; executive commitee, H. W. Cutshall, W. B. Swaney, M. A. Reed and E. E. Piper.

The Capital City Telephone Company of Raleigh, N. C., with an authorized capital of $200,000, has been incorporated by Julian S. Carr, G. W. Watts and L. A. Carr, of Durham; W. T. Gentry, D. I. Carson, J. W. Crews and Hunt Chipley, of Atlanta, with power to combine and consolidate the Bell and Interstate. There is a third company in Raleigh, called the Raleigh, which will not be affected, and will have the only Independent exchange in North Carolina.

The Supreme Court of Topeka, Kan., has rendered a decision of far-reaching importance to telephone companies operating in that State. It holds that a telephone company must make its peace with adjoining land owners before using a country road as right-of-way for its telephone line.

The following directors have been elected by the Co-operative Telephone Company, of Crawfordsville, Ind.: Samuel Fraley, George W. Bowers, Charles Beck, W. H. Nicholson and M. E Clodfeler.

The North Eastern Rural Telephone Company, Jewett, Ia., capitalized at $1,000, has been incorporated by J. E. Baker, and L. H. Ayer, Jr.

A. C. Hoefner has been elected president, and J. H. Meier, Jr., secretary of the New Melle, Mo., Telephone Company.

Chicago Company to Build.

The Chicago Telephone Company has completed its lease from David C. Cook of the plot of ground fronting on Calhoun place in the rear of 96 Washington street, on which it will construct a building to cost $200,000. The ground is 80 x 72 feet, and is on the north side of Calhoun place, 100 feet west of Dearborn street. The lease is for 99 years from December 1, 1903, at a rental of 4 per cent. upon $200,000. The telephone company binds itself to construct by December 31, 1904, a fireproof building not less than four stories high to revert to the lessor at the end of the term.

The Iowa Telephone Company has removed its general office from Davenport to Des Moines. It is understood the company is intensely interested in legislative matters which will come up this winter. One of the laws that the company desires changed is that regarding franchises in certain cities and towns. The renewal of franchises has been the bane of the company for the past few years, and it is understood an effort will be made to secure legislation that will extend the franchises indefinitely and give the company more rights than it has hitherto enjoyed. President E. B. Smith, it is said, will remain in Des Moines practically all the time during the session of the general assembly or until the matters in which he is interested are completed.

The fight between the telephone companies in Washburn, Wis., appears to be about even, with a little difference in favor of the local Independent company. The old company has refused in many instances to take out instruments when ordered, the result being that the principal business houses find it necessary to keep both instruments. The new company has toll lines in the surrounding places and its line into Bayfield.

The South Shore Telephone Company, whose principal headquarters are at Freeport, N. Y., has filed an amended certificate of incorporation with the Secretary of State. Its lines extend from the Borough of Manhattan on the west to Montauk Point on the east. The capital stock is $20,000, consisting of shares of $25 each, and the directors for the first year are George W. Bergen, Henry P. Libby, William G. Miller, John J. Randall and George P. Bergen, of Freeport.

The borough council of Woodstown, N. J., is considering two ordinances that will mean much to the town. One is for a system of improved sidewalks, and the other for the Eastern Telephone Company, which promises to furnish 'phones at much lower rates, if granted a franchise, than residents are now paying.

The Wilhelm Telephone Manufacturing Company, of Buffalo, N. Y., has been incorporated with a capital of $5,000 to make and sell telephones. The directors are Theodore H. Meyer, Henry A. Brehm and Walter L. Wilhelm.

Three times within a few weeks the telephone booth in the Orange, N. J., station of the Lackawanna Railroad has has been broken open, and all the cash in the automatic device taken.

Telephone Clearing House.

At a conference of representatives of Independent telephone companies recently held in Des Moines, Ia., measures were taken for the establishment of a telephone clearing house. It is the expectation to turn into the clearing house all tolls received by the companies and afterward pro rate them on a mileage basis. The clearing house will be under the direction of a manager selected by the companies.

The stockholders of the local telephone system at Kimball, S. D., lately held their annual meeting. The report of the secretary proved that the company was in good financial condition. Although the system was constructed only last April, and a great many improvements have been made since that time, a dividend of 2 per cent. was declared. The company has no indebtedness. At a meeting of the new directors the following officers were elected for the coming year: President, Dr. Willy: vice-president, C. R. Tinan; secretary, A. S. Stuver; treasurer, H. W. Hinrichs; general manager, A. M. Bowles.

The Central Union Telephone Company at Alexandria, Ind., will put in a new switchboard and change its system from a magneto bell to a central energy system. The strong competition of the Delaware & Madison Counties Company has forced the Central Union people to put up a fight, and while rate-cutting has not yet begun, it is expected when both systems have equal equipment. The city has over 800 'phones, about evenly divided.

The possibility of the postoffice department installing a system for using cars in the tunnels of the Illinois Telephone & Telegraph Company in Chicago, to carry mail between the new postoffice and the railway stations, is said to be strengthening.

The Western Independent Telephone Company, of Kansas City, Mo., has filed a certificate of increase of capital stock from $21,000 to $1 500,000.

A. C. Whidden, assistant treasurer, and M. L. Paige, auditor of the Northwestern Telephone Company, of Minneapolis, Minn., have resigned from their positions.

The Farmers' Telephone Company, operating in the vicinity of Brown Mills, N. J., has reduced its rates to $18 a year, entitling each subscriber to 400 calls.

The Chequest, Ia., Farmers' Telephone Company held a meeting recently and decided to construct a new line to Lebanon.

The new Homer Telephone Exchange at Homer, Mich., has 160 subscribers.

Telephone Incorporations.

The York Telephone Company, Nelsonville, O Capital stock, $1,000. Incorporators: M. S. Wollett, J. W. Bennett, E. R. White, J. M. Bennett and J. G. Filley.

The Egyptian Telephone & Improvement Company, Fairfield, Ill.—to operate telephone, electric light and heating systems. Capital stock, $2,500. Incorporators: C. M. Brock, Luke Whitson and John A. Morian.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Akron, N. Y —The proposition to issue bonds to the amount of $10,000 for an electric light plant was lately carried.

Ashley, Pa.—The Ashley Electric Light & Power Company, was recently incorporated with a capital stock of $30,000.

Athens, Mich.—The Athens Electric Power & Lighting Company has been formed with a capital of $15,000.

Augusta, Ky.—According to plans submitted the waterworks and electric light plant proposed to be built here will cost a total of $47,000 -$11,000 for electric lights and $36,000 for the waterworks.

Barberton, O.—A franchise has been granted to O. C. Barber to furnish electric lights for a portion of this city.

Belmont, O.—Sealed proposals will be received at the office of A. W. Beatty, county auditor, until January 18, for furnishing, installing and equipping a complete electric light plant in the Belmont County Infirmary buildings.

Bernville, Pa.—This village is to be lighted with electricity.

Bradford, O.—The electric light plant here has been totally destroyed by fire.

Brockville, Ont.—The light commissioners have asked for an expenditure of $25,000 on the electric light plant.

Burgettstown, Pa.—Indications are that this town may have an electric light plant soon.

Capac, Mich.—The Fisher Electric Company of Toledo, O., has obtained a contract for the erection of a municipal electric lighting plant here. A 200 hp. boiler, a 150 hp. automatic engine, a 75 kw. alternating current generator and other equipment will be installed.

Durant, I. T.—This town will sell $89,000 bonds for waterworks and electric lights.

Elmer, N. J.—The borough council is considering lighting the streets with electricity.

Fort William, Ont.—This city may issue $15,000 debentures for improving and increasing the power of the electric lighting system.

Hannibal, Mo.—This city may vote on the proposition for the sale of the municipal electric light plant, which is said to be in poor condition, and which would require $10,000 expenditure to put it in proper shape.

Jackson, Mich.—A municipal electric lighting plant is being discussed here.

Joplin, Mo.—Bonds to the amount of $30,000 may be issued for light plant improvements.

Marysville, O.—A franchise for an electric light plant here has been granted D. J. Long, of Mechanicsburg. A $25,000 plant will be erected, work being started at once.

Menasha, Wis.—The Winnebago Traction, Heat, Light & Power Company has asked for a franchise for bringing its light and power wires into this city to furnish commercial light and power.

New Haven, Ind.—The establishment of an electric light plant is favored by the village citizens. H. H Schneilker is at the head of the movement

New Orleans, La.—The city budget for 1904 includes the sum of $8,000 for the installation of new lights.

Northumberland, Pa.—The Northumberland Electric Light, Heat & Power Company has been incorporated with a capital stock of $5,000, The directors are J. Lauterstein, G. R. Van Allen, H. C. Taggert and others.

Orange, Tex.—It is reported that extensive additions to the electric light system of the Ice, Light & Waterworks Company are to be made. S. C. Tremble, Hillsboro, Tex., is general manager.

Plainfield, Ind.—Plans are reported as being made for an electric light plant and waterworks of the recently incorporated Public Service Company, of which Wm. B. Vestal is president. Bids will probably be received soon.

Pendleton, Ore.—The Northwest Gas & Electric Light Company, represented by Dr. F. W. Vincent, has offered to increase its lighting facilities if the city would enter into another contract. The company intends, it is said, to erect a $500,000 power plant in Umatilla County.

Rantoul, Ill —This village is taking steps to have an electric light service.

Rio Vista, Cal.—J. F. Hayes, of the Solano Electrical Works of Vallejo, is said to be considering the establishment of an electric light plant here.

San Pedro, Cal.—W. H. Eddy and W. F. Carlton, of Boston, Mass., have been considering the establishment of an electric light plant here.

Truckee, Cal.—This town is to have a new and modern electric plant, which will furnish a day and night service.

Van Buren, Ind.—M. Otto Bish and John McDougla are organizing a company to build an electric light plant here to cost $10,000.

STREET RAILWAYS.

Allenport, Pa.—The farmers of Allen Township will build an electric line from here to Roscoe.

Beloit, Wis.—An electric road from here to Elkhorn will soon be built by the capitalists now controlling the Rockford, Beloit & Janesville line.

Carlyle, Ill.—The Carlyle Commercial Club is considering a proposition submitted to the Buxton Coal & Mining Company, which proposes to furnish the power to operate an electric railway between here and the mine, provided the citizens build the line.

Centralia, Ill.—The city council is discussing the question of granting a franchise to the Southern Illinois Electric Railway Company to build a line through this city.

Defiance, O.—The Ohio Northern Traction Company, which was recently incorporated with $10,000 capital, will build a line from here to Wauseon.

Harrisburg, Pa.—The directors of the Star Trolley Company, which was chartered to run a network of lines over the lower end of Cumberland County, and in which considerable Harrisburg capital is invested, held a recent meeting at Mechanicsburg, and decided to order immediately all rails and supplies necessary for the completion of the road, which will be started as early in the spring as the weather will permit. C. B. Miller, of this city, is one of the directors of the company.

Hastings, Neb.—Charles A. Baker, a representative of the Nebraska Central Electric Railroad Company, has been negotiating for the right of way for the proposed electric line to connect this city with Omaha.

Liberty Center, O.—The Rapid Transit Railway Company has been granted a franchise to build a line through this town on North street.

Los Angeles, Cal.—An ordinance has been adopted granting to Edward Colter the right to construct, and for 33 years to operate a double track electric street car line in this city, commencing at Main and Jefferson streets. The work is to begin within four months from date of franchise. H. J. Lelaude, city clerk.

Minneapolis, Minn.—The Minnesota Power & Trolley Company will build a trolley line from St Paul through this city.

Mt. Vernon, Ill.—A franchise has been granted by the city council to the Southern Illinois Electric Railway Company to operate an electric railway over certain streets.

Norwalk, O.—There are now very bright prospects for the building by the Buckeye Traction Company of the electric railroad south from here through North Fairfield; Steuben, Chicago Junction and Plymouth to Shelby and thence to Mansfield. Philadelphia men say that they now stand ready to build the road at once if the franchise is renewed and the right of way is again secured.

New Richland, Minn.—John Willis proposes to build an electric line from here to Madison Lake.

Paulsboro, N. J.—The Paulsboro Traction Company has secured all the stock, and work on the new trolley line will commence as soon as spring opens.

Pittsburg, Pa.—The Pittsburg Railway Company will construct a trolley line from Washing to Findleyville.

Portland, Ore.—The Oregon Traction Company will build a line from here to Forest Grove.

Pottstown, Pa.—J. M. Zook, of Exton, is one of the promoters of the proposed trolley road between West Chester and this place.

Springfield, Ill.—A new electric railway company has been organized here to be known as the Springfield, Moweaqua, Sullivan & Mattoon Railway Company, J. B. Titus is president.

Stockton Cal.—R. G. Paddock has been here preparatory to filing an application for a franchise for building a new electric line into this city.

Windfall, Ind.—A right of way for an electric road from Marion to Tipton is being sought by certain parties, and it is claimed it will pass through here. R. M. Van Buskirk is interested.

Youngstown, O.—The Beaver Valley Traction Company will spend $15,000 in improving and extending its lines.

POWER PLANTS.

San Francisco, Cal.—The report from San Jose that valuable water rights had been transferred to Frank Drum, of this city, is believed to be a step toward developing electric power.

Wadhams Mills, N. Y.—D. F. Payne, of this place, who owns a water power here of 48-foot head, is arranging with Port Henry people to install an electric light system there with power transmitted from Wadhams Mills.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅝@12½c; Lake 12½@12⅝c.; casting, 12¼@12⅜c.

The Portable Electric Safety Light Company, Jersey City, has been incorporated with a capital stock of $250,000.

Small lots of stock of Bell Telephone of Philadelphia came on the market on Monday at 52½, against previous sales at 53.

There are now 132,000 telephones in use in Manhattan and the Bronx, being an increase of 76,000 during the last three years.

Electric Vehicle stock on Monday showed considerable strength. The common stock advanced 1¼ and the preferred reached 12½.

Buying in New Jersey Traction in Philadelphia last week advanced the price two points and cleared the market of floating stock as well.

The Interurban Street Railway Company of this city is to assume the new name of "New York City Railway Company" on and after February 10 next.

Justice McCall in the Supreme Court has denied the application of John F. Doyle to examine the books of the Metropolitan Street Railway Company of New York.

The Detroit United Railway Company has sold $500,000 general mortgage 4½ per cent. bonds to E. H. Gay & Co. The price realized was in the neighborhood of 98.

The Russell Electric Company of New York was incorporated at Albany on Monday. The directors are G. W. Russell, Jr., Minnie C. Reddon and J. H. Taylor of New York.

Pittsfield, Mass., capitalists are backers of the proposed electric line between Westfield, Mass., and Hudson, N. Y., as a connecting link in the line to parallel the Boston & Albany its entire length.

The Georgia Electric Railway Company has declared the regular quarterly dividend of 1¼ per cent. on its preferred stock, payable January 20. Books close January 11 and reopen January 21.

The Syracuse (N. Y.) Rapid Transit Company has prepared a report of the business done during the past fiscal year. Some idea of the traffic can be gained from the fact that 15,528,910 passengers were carried exclusive of transfers.

It is figured out that Philadelphia Electric's gross earnings for 1903 will be $3,200,000 against $3,422,411 for 1902 and that the net surplus after dividends are paid will be $788,567 against $563,567 in 1902. But the stock continues weak.

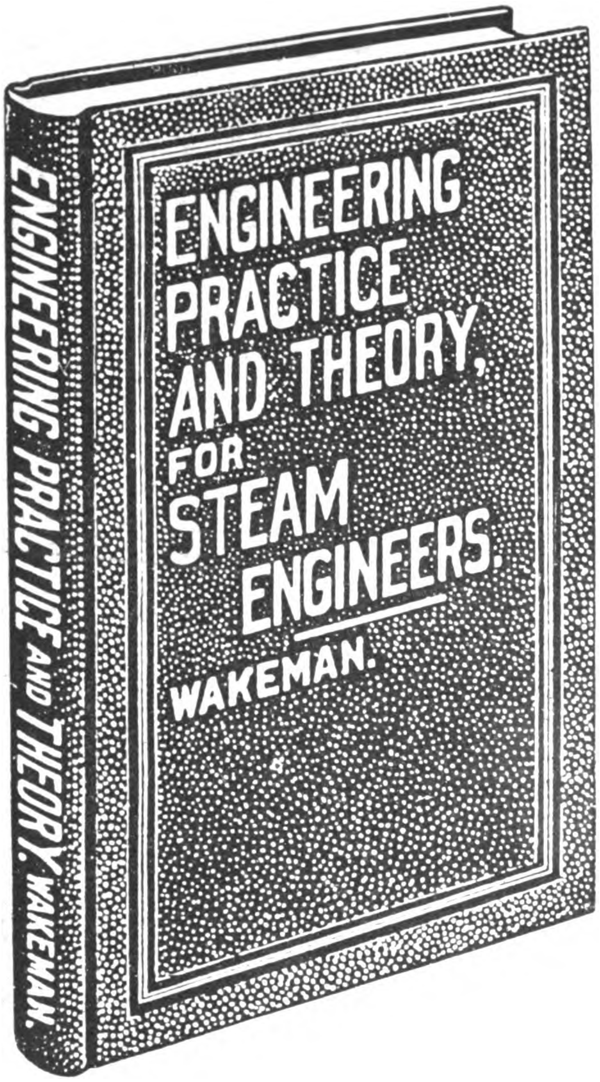
The creditors' committee of the Worcester & Southbridge (Mass.) Electric Railroad Company will recommend the acceptance of the receiver's proposition, which provides that preferred creditors shall receive 50 per cent. and others 40 per cent.

At the annual meeting of the Boston Elevated Railway Company on Monday the old board of directors was re-elected. The total number of stockholders is 2,554, holding 133,000 shares of stock. More than 80 per cent. of the stock is held in Massachusetts.

A dispatch from Chicago says that the Union Traction Company's business in December showed about $2,000 a day gain. The City Railway kept up its average of November, with something to spare. The other Chicago companies made relative gains for the month over those of the corresponding month a year ago, and the preceding month in 1903.

ELECTRICAL STOOK QUOTATIONS.

Name.	Closing price Jan. 4.
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	142
Metropolitan Street Railway	121⅛
Metropolitan Securities	873
Ninth Avenue	200
Third Avenue	120
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	49
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	269
Philadelphia.	
Consolidated Traction of New Jersey	64
Philadelphia Traction	95
Union Traction, $17.50 paid	45⅛
Boston.	
Boston Elevated, full paid	140
West End Street, com	94
do. do. do. pref	110
Chicago.	
City Railway	160
North Chicago	87
Union Traction, com	6¾
do. do. pref	30
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	21
do. do. pref	50
Electric Lead Reduction	⅛
Electric Vehicle, com	7
do. do. pref	12
Westinghouse, com	166½
do. pref	193½
General Electric	170½
Boston.	
Edison Electric Illuminating	233
General Electric	170½
Massachusetts Electric Companies, com	19
do. do. do. pref	76
Westinghouse Electric & Mfg., com	83½
do. do. do. pref	92
Chicago.	
Chicago Edison	144
National Carbon, com	21½
do. do. pref	90
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	58
do. do. do. pref	58
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	125½
Western Telephone Company	8
New England Telephone Company	122½
New York.	
American Telegraph & Cable Company	82
Commercial Cable Company	149¼
Mexican Telephone Company	1¾
New York & New Jersey Telephone Company	140
Postal Telegraph Cable Company	....
Western Union Telegraph Company	86¾
Miscellaneous.	
Chicago Telephone Company	120
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	26½
Consolidated Car Heating	66
Standard Underground Cable	220



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CONTENTS.

EDITORIAL NOTES.

Electricity vs. Steam.

The recent heavy fall of snow accompanied by zero weather would seem to have demonstrated the advantage of electric traction over traction by steam.

Last week practically every railroad leading out of New York City was in trouble. The train schedule was a farce and business men living in the suburbs would start for one train and catch the next, after waiting anywhere from one-half hour to an hour on a cold platform or in a colder car.

This enforced delay was to a great extent due to the freezing of the water in the engines. A locomotive would lie out in the yard three or four hours in a zero temperature with the result that the water in the tender would freeze and frequently its pipes as well.

This all had to be thawed out before it could be run in and coupled to its train and travelers had to wait.

But, while the engineers and firemen in the railroad yards were wasting schedule time melting ice, the trolley roads connecting from New York and running out into Jersey were operating practically on time. A few snow plows cleared the track and after that everything was clear sailing, and no matter how cold it became there was no ice on the motors to be melted.

This certainly speaks well for electric traction under severe conditions, and the time will come when up-to-date railroads will operate their short-distance or suburban trains by electricity instead of by steam and save its commuters during the winter months, if not actual suffering, inconvenience and loss of time and money.

Electric Roads as Freight Carriers.

Electric traction is becoming a recognized factor in the transportation of freight for short distances. During the past few years this industry has increased very rapidly, and many rural communities throughout the country depend almost entirely upon the electric railroads for the transportation of their products to nearby markets. The development of this branch of electric transportation has apparently assumed greater proportions in the Middle Western States than in any other part of the country, although there are examples of it in practically all parts of the United States. Electric lines are also used to some exent as "feeders" to steam railroads, hauling the loaded freight cars of the latter from the junction of the two roads to communities many miles distant by means of an electric motor. After the cars are emptied freight destined for points on the steam road, or points on some one of its connecting lines, is then loaded into these cars, which are again delivered to the steam railroad. In almost all cases the management of the electric road is entirely independent of that of the steam road.

The importance of electric lines as freight carriers must be considered, as yet, to be very slight, but there are individual instances of really remarkable development, and several lines give the territory through which they operate service equivalent to that given by the steam railroads, carrying practically all commodities, either in carload or less than carload lots. In many cases farming districts adjacent to cities are served by electric lines; garden truck, milk and live stock are carried to market in freight or express cars, while the farmer procures his supplies from the city in the same manner.

The freight equipment of different roads,

of couser, varies greatly. Where the business is small, a combination passenger and baggage car often meets the requirements, while there are many roads which are able to meet all demands for freight transportation with one or two box or flat cars. There are instances, however, where the freight equipment is very large, reaching as high as 90 freight cars for a single road, and including box, flat and combination cars.

Freight rates vary greatly between different roads for like distances. When an electric line parallels a steam road it generally bases its rates upon those of the steam line. The official classification used by the steam railroads in the territory east of Lake Michigan, Chicago and the Mississippi River, and north of the Ohio and the Potomac Rivers to the Atlantic seaboard, is used to some extent by electric lines in this territory for the purpose of classifying their freight. Printed tariffs embracing a great number and variety of commodities are issued by a number of lines.

A line running out of Portland, Ore., aptly illustrates the development which is, at present, possible in freight transportation by means of electric traction, and a brief history of its growth, therefore, is worth recording. This line has carried more or less merchandise since 1892. The original service was for express packages only, but it has gradually been extended until to-day all classes of merchandise are carried, including farm produce, lumber, and logs in carload lots. The freight equipment consists of 6 freight motors, 10 box cars, 76 flat cars, and four 55-foot combination passenger, milk and express cars, having capacities ranging from 30,000 to 50,000 pounds, and all being equipped with patent couplers and air brakes. Two trips daily are made over the line, and special trains are also operated as business demands. Two freight stations, located at Portland and Oregon City, have been established.

This company has entered into an agreement with the Southern Pacific and Oregon Railway & Navigation Companies for the interchange of freight traffic by which the cars of the above companies are loaded on this company's lines and delivered for shipment to points on the transcontinental lines or east thereof. It has also an agreement by which it handles the pouch mail for the postal authorities between Portland and Oregon City and between Portland and Bering, beyond which point arrangements are now being made for a regular railroad mail service.

While the development of freight transportation by electric lines has been very rapid in the past few years there are many reasons to believe that an increased growth in the future is to be expected. Many roads which have not yet a freight service have indicated their purpose of establishing one, and a number which are carrying only a small amount of freight expect to increase their tonnage by improving their freight-carrying facilities.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The American Institute of Electrical Engineers has accepted the trusteeship of a fund which is being raised by the Edison Medal Association to celebrate the 25th anniversary of the introduction and commercial development of the incandescent lamp. On February 11, Thos. A. Edison's birthday, the inventor will be the guest of honor at the annual dinner of the Institute at the Waldorf-Astoria, and the fund will then be formally presented. The National Sculpture Society will select the competitive design for the medal, which, it has been suggested by Mr. Edison's friends, should be of platinum, in view of the remarkable importance of that metal to lighting and other electrical arts. The permanent maintenance fund will be about $5,000. The medal will be awarded annually to graduating students in electrical engineering.

Prof. Ramsay, when asked recently if he believed radium would ever have a commercial value, said, "I don't believe radium will ever be commercially useful. Medically it will be."

A despatch from Paris on Saturday says: "As a result of recent negotiations it is announced that the Mediterranean Thomson-Houston Company and the German Societe Generale d'Electricite have been amalgamated. The new company will have a capital of $1,200,000. There has been no conclusion of the negotiations for the amalgamation of the French Thomson-Houston Company into the combination, but no hitch has occurred, so far as is known."

The technical committee appointed by the Prefect of Police of Paris to investigate the accident on the Metropolitan at the Couronnes Station last summer, and to suggest improvements, has finished its work, and M. Picou has handed in his report. One of the first things he suggests is that the driver should be able to lift the contact shoe running on the third-rail without leaving his post. As the cars are at present constructed the driver must leave his cabin, go to the side of the car and lift the shoe with his hands. The next important modification suggested is the division of the electric current in the third-rail into sections, so that only a given number of trains may move within a certain section. Each section, moreover, is to be supplied by special cables, which are to be shut off automatically in case of accident or oversupply. Between the stations and at short distances apart all along the line switches should be established by means of which the current may be shut off from all or several sections without resort to the telephone. This would forestall danger from the third-rail in case the passengers had to leave a train between stations.

A special committee of the common council of Binghamton, N. Y., has reported adversely on the question of a municipal electric light plant. It is admitted among other things that the item of labor would cost the city 25 per cent. more than it does the present company.

Electricity in Cincinnati, O., during the next ten years will be sold to private consumers, and for use in public buildings, at not to exceed 12½ cents per kilowatt.

An announcement has been made that a new and unique school of electrical engineering would be founded during the current year by L. L. Nun of Telluride, Col., who is at the head of the electrical power companies operating at Niagara Falls, N. Y., and in the West. It is the intention of the founder to give a full course in mechanical and electrical engineering at Provo Canon, Utah, keeping the students actually employed and under pay during the period of their course.

American electric traction equipment has become so popular in Great Britain that several municipalities in that part of the world specify that bids will only be considered which include Yankee material.

The wealthy Zemindars and Maharajahs of India are using electricity very largely for the lighting of their palaces. The Maharajahs of Dharbanga has just placed an order with a Calcutta firm for the installation of an electric lighting plant for his new palace at Raynagar, which will cost over $100,000.

THE MONEY VALUE OF TECHNICAL TRAINING.*

BY JAMES M. DODGE.

Technical training may be self-acquired or obtained through instruction. The ability to drive a nail properly, or to design and construct the most complex and wonderful of structures or devices, is the result of technical training in but different degree. Up to a very recent date, and within the memory of most of us, the apprentice system and that of independent delving represented the sole methods of acquiring training. Research and investigation carried on in individual lines, with varying degrees of success, dependent upon the mental make-up of the individual were the means of attaining theoretical technical knowledge. The blending of these two methods developed the earlier mechanical engineers and will, even in the future, enable those sufficiently gifted by nature and habits to attain eminence. The progress of the world, however, calls for a better and more speedy means of producing trained men than could ever be developed by the methods of self instruction. The individual striving for manual skill attains his desire under the old apprentice system. Individuals sufficiently gifted rise above their fellows, and become the leaders in their calling. The gratification of a mechanical appetite and the desire to earn more money than his fellows are two moving causes which impel a man towards technical education. A generation or so ago, the universal belief was that the sooner a young man entered upon his apprenticeship, or began practical manual work, the better and more rapid would be his progress in the mechanic arts, and book learning was derided as being purely theoretical and of little practical value. This belief is, even at this date, all too prevalent, largely due to inherited error and to lack of knowledge and reliable data.

Obtaining data from which incontrovertible conclusions can be drawn is now comparatively easy, but a few years ago was practically impossible. We are all prone to take extreme cases of success or failure as the basis of our opinions, and lose sight of the fact that it is the average man whose career shows the true force and direction of the current. For convenience of comparison, I will outline the actual progress made by four groups of men working in the mechanic arts—the unskilled labor group, the shop-trained or apprentice group, the trade school group, the technical school group —and give the results attained. Each group I will refer to as an individual:

Labor.—The first is the laborer, with but primitive and rudimentary training, working under the immediate and constant supervision of a boss, and earning, as the line on the chart indicates, $10.20 per week at the age of 22, his line remaining horizontal through the period of his usefulness. Data are lacking as to his progress before he reaches the age of 22.

Apprentice.—The second, the apprentice or representative of the shop-trained group, of good health and habits, entering a machine shop at the age of 16, earns an average wage of $3 per week for 50 weeks per year, which is about the number actually worked, amounting to $150, or 5 per cent. on $3,000. This, then, is his potential or invested value upon which he draws his interest on pay days.

On the chart accompanying this paper, ruled horizontally, are lines representing amounts increasing from the lower line upward by $1,000 each, starting at $1,000 and terminaiing at the top at $50,000, these representing potential values, upon which 5 per cent. is earned for 50 weeks a year. The vertical lines each represent one year in time, beginning at the lower left hand corner at 16, and progressing in regular order until, at the lower right hand corner, we have 32, representing in all a lapse of 16 years.

To illustrate the progress of the four groups graphically, we indicate on the line representing 16 years of age, and opposite the figure $3,000, the young man just entering his apprenticeship. We will consider him typical of the shop-trained group. Following the line to the right we see his average progress in earning capacity through the ensuing years, noting that at the age of 20 he is earning $9 per week, which is 5 per cent. on $9,000, he having increased his potential or invested value in four years by $6,000.

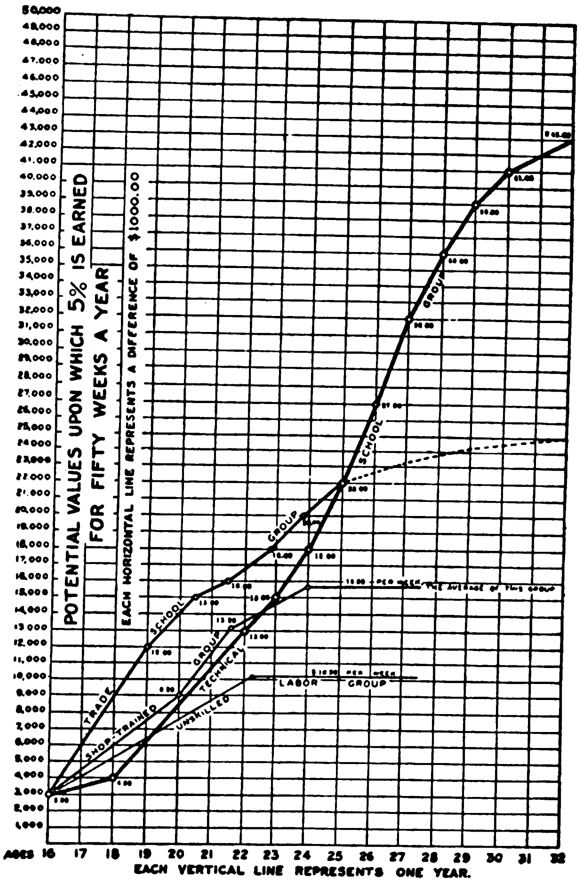

DIAGRAM SHOWING THE MONEY VALUE OF A TECHNICAL EDUCATION.

We now note that his accumulated experience enables him to make more rapid progress for the next year and a half, and from the age of 20 to 21.5 years of age we find that his pay his increased to $13.20 per week, and his potential value to $13,200. He is now approaching his goal, and his line of progress does not continue at the same angle that it followed for the past few years, but deflects towards the horizontal; at the age of 24 we find him earning $15.80 per week, and his potential value $15,800. In other words, in 8 years he has increased his potential value $12,800. Observation shows that 5 per cent. of the apprentices acquiring the machinist trade rise above the line made by our average man, while 35 per cent.

* President's address before the December meeting of the American Society of Mechanical Engineers, held at New York.

follow the line closely; that during the period of training 20 per cent. leave of their own accord, and, as near as can be ascertained, go to other shops to continue in the line originally selected; 40 per cent., however, are found unworthy or incompetent, and are dismissed, probably never rising to the $15.80 line.

Apprenticeship of to-day in many establishments does not make the man, broadly speaking, a mechanic. In a majority of cases he is a specialist or tool hand, and not comparable with the old mechanic, who was a worker in metals, had some practical knowledge of steam and prime movers, could chip, file, work on lathe, planer, drill press, or as an assembler, and was competent to meet the varied and unusual conditions found in general construction and repair work.

Trade School.—The third group of young men are those fortunate enough to have had the opportunity of entering a trade school, which they do at 16 years of age, devoting the next three years of their lives acquiring a trade under competent instruction, and at the same time adding to their store of rudimentary theoretical education. At the age of 19 a trades' school man enters the machine shop and can command $12 per week, equal to the apprentice at 21 years of age, and very quickly makes his employment profitable to his employer. The three years in school have increased his potential value from $3,000 to $12,000, a gain of $9,000. Thus he has caught up with the apprentice entering the shop at 16, and who has been working for five years. Progress of the trades' school group now follows a line which diverges from that of the regular apprentice, and by the time $15.80 is earned by the regular apprentice, the trades' school graduate is earning $20 with a potential value of $20,000, or $4,200 greater than that of the shop-trained man. The trades' school line continues at substantially the same angle up to an earning capacity of $22 per week and a potential value of $22,000. Data are lacking as to the further progress, but the presumption is that this line will bear off more toward the horizontal, eventually paralleling the line of the shop-trained man, but much higher on the chart.

Technical School.—The fourth group we will represent by a boy of 16 studying at school until his 18th year, and preparing himself for admission to one of our higher institutions of technical learning, such as the Stevens Institute, the Massachusetts Institute of Technology, Columbia or Cornell, where, after a four years' course, or at the age of 22, he is ready to begin practical work. The statistics upon which this chart is based show the average starting wage at $13 per week, or the amount earned by the regular apprentice at the age of 21.5, and by the trades' school graduate at the age of 19.5. In other words, apparently a graduate of our technical schools has lost by his six years of preparatory study, having been beaten by the regular apprentice by six months and by the trades' school graduate by 2.5 years. From this time, however, there develops a most interesting and instructive line of progress. The regular apprentice, who is earning $13.50 a week at the time the technical graduate is earning $13, is overtaken in six months, and we find both earning $14 per week, and the technical graduate reaches the $15.80 line nearly one year before the regular apprentice. In other words, while it has taken the regular apprentice from his twenty-first to his twenty-fourth year to increase his wages from $11.50 to $15.80 a week, the technical graduate has done the same in 15 months.

Progress now continues on substantially the same line, and we find the technical graduate earning $22 per week and crossing the line of the trades' school group in three years' time, a worthy tribute to the higher education and attainment.

The line of the technical graduate now continues divergent from that of the trades' school graduate, with earning capacity regularly increasing, and a corresponding augmentation of potential or invested value until, at the age of 32, or ten years after entering upon practical work, we find our technical graduate earning $43 per week and his potential value at $43,000. In other words, six years of preparation have enabled him to distance the shop-trained man and the trades' school graduate overwhelmingly. Bearing in mind that this is an average line, it is of interest to say that most technical graduates with a better record than the one in the chart have devoted even more time to their preparation, either by study or shop-work, after graduation. Those, on the other hand, who have not come up to this average line represent, in the main, men more or less incapable of original work. The reason that higher education, other things being equal, carries with it the ability to earn high wages is that consciously or unconsciously these men are directing and making it possible for large numbers of laborers, shop-trained men and trades' school graduates to perform useful work. A draftsman at his board may never realize that as a result of his drawing 100 men or more may be given employment. His design calling for structural steel, for instance, could not be built were it not for the labor of many men employed in making and rolling the steel before it reaches the shop. Then come the shop men, who cut, punch and shear, and then the erectors, who assemble the structure in accordance with the original plan. For this ability and knowledge our technical man is paid.

It is quite obvious that all workers in the mechanic arts cannot be technical graduates. Some must, through natural limitations, or lack of opportunity, follow the apprentice line, and others the trade school. It is from graduates of the latter that leading shop men and foremen are largely selected. These two classes, supplemented by the technical graduate, constitute the vast army of workers in the mechanic arts.

Thus we see clearly that preparation pays and that it pays in dollars and cents, and that even a long term of years spent in proper study and technical training is a good investment from every point of view.

Of course, apprentices have made and will make, in rare instances, a better showing than the average technical man of the chart, and many of our greatest men have, by sheer force of character, excellence of brain fiber, persistence and self-education risen to pre-eminent positions, independent of all regular systems. To the end of time great examples of this kind will be found. Among those whose names readily come to mind are the elder Krupp, Joseph Whitworth, George M. Pullman, Andrew Carnegie, John Fritz, Prof. John E. Sweet, Edwin Reynolds, George H. Babcock and Coleman Sellers. The same is true of the trades' school graduate, but as said before, we are dealing with the average of each class, taken from actual statistics, with an earnest desire to ascertain the facts, and without any preconceived notion of the outcome.

It may be stated as a truism that every man pays for the amount or percentage of bossing he requires, and conversely, every man's wages increase in proportion to his ability to act as a boss or foremen of himself and others. The lower the wage rate the greater amount of watching and directing constantly required. The slaves of ancient Egypt received no wages, but were treated as horses are to-day. They were fed and sheltered according to the ideas of their owners. No slave worked voluntarily, and the foreman's or leader's excellence was gauged entirely by his

physical strength and efficiency as a driver. This was certainly the zero of labor conditions.

The highest wages are paid to the man through whose ability the largest number of other men may be most profitably employed. He does his work with his brain. Thus, on the one hand, we see manual labor receiving no wages, and on the other mental labor reaping the highest reward. Between these two extremes is found every condition of human life.

A practical man performs his work within the radius of his arm, a technical man within the radius of his brain. The fact is, even to-day, realized by the few, but it is gratifying to know that the number is increasing. The technical training of an individual makes him valuable just in proportion as his ability is manifested by good judgment and perception. Trained common sense receives the highest compensation and reaps the greatest reward. Mental ability to receive ideas and impart them properly and wisely, rearranged and grouped, is typical of the most brilliant mentality; a dull intellect may be compared to blotting paper, fit only to absorb and inter a heterogeneous mass of impressions.

The most interesting of all graphical charts would be that properly exploiting the value of technical training to manufacturing plants and enterprises. To illustrate this more clearly, we may fairly assume that the apprentice of our chart corresponds to the old-fashioned primitive shop, having practically no overhead expense, the proprietor carrying the business "in his hat," priding himself on his non-respective sturdiness, contempt for improvements and personal attention to all details. For his costs he adds together the value of raw materials and labor, and then a few dollars for profit. The line of this establishment would parallel the $15.80 line of our shop-trained group.

The trades' school line on the chart truthfully represents establishments in which some attention has been paid to the improvement of system, with an increased so-called non-productive force, operating possibly in some particulars with brilliancy, but with defective features in others; acknowledging the value of improvement if internally originated, moderately but unconsciously absorbent of ideas from without, but tenacious of dogma and lacking departmental symmetry. Growth, increased earnings and relative immunity from disastrous failure result.

The technical graduate line of our chart represents the manufacturing establishment technically trained and "abreast of the times" in all particulars, and I predict a time not very far distant when it will be almost universally recognized that establishments should be trained as well as individuals, and that the marvelous development in scientific shop practice and management will do for the manufacturer fully as much as technical training is doing for the individual. A change of mental attitude towards the subject of advanced shop practice and management is noticeable to a marked degree. Within a very few years, indifference and antagonism have changed to a growing interest and appreciation.

ELECTRIC LIGHT AND POWER GAS ENGINE PLANT AT USTER.

BY FRANK C. PERKINS.

The city of Uster, near Zurich, Switzerland, has a large number of small industries using more or less small power, and it became evident that a lighting and power plant would be of great value in that vicinity. The installation was supplied with apparatus by the Maschinenfabrik Oerlikon of Oerlikon, Switzerland. It was deemed most advisable to utilize gas-engine-driven electric generators, not only on account of their great simplicity and entire absence of boilers and their accessories, but also on account of the high economy obtained. The central power station included a building large enough to contain the gas plant, an engine and generator room, a storage battery plant, a coal and gasometer room. The power plant at Uster is seen in Fig. 1. The interior of generator and engine room, which covers an area of 234 square meters, is seen in Fig. 2, while the gas generating plant may be noted in Fig. 3, and covers 117 square meters.

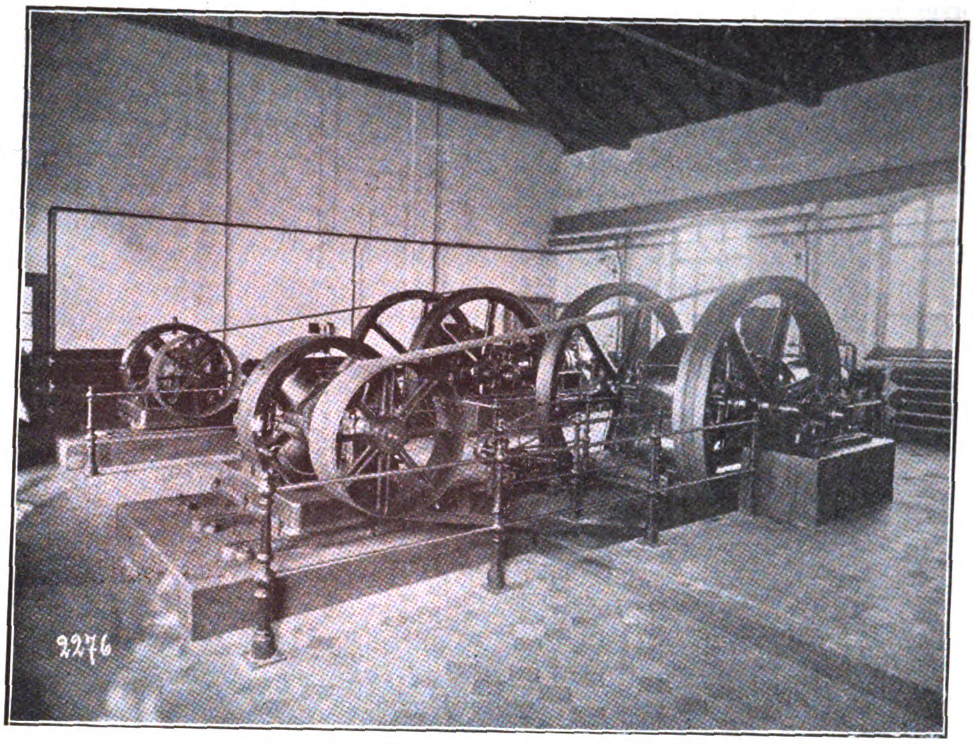

Fig. 2.—Gas Engine and Generator Room in Power Plant at Uster.


Fig. 1.—Central Power Station at Uster.

The gas generating plant has a capacity of 125 hp. and was installed by the Maschinenfabrik Deutz, who also supplied the gas engine now in operation. Both of the gas engines are of the horizontal, single-cylinder type, with a normal capacity of 80 hp. and a maximum capacity of 100 hp. The generators are

driven by the gas engines by belt transmission and heavy fly-wheels are employed for obtaining steady motion. The electrical generators are direct current shunt-wound machines of the Oerlikon type, having a capacity of 80 hp. The generators have each two commutators, each of which supply 200 amperes, while the speed of the machines are 560 revolutions per minute. The pressure at the terminals can be varied from 125 volts to 175 volts, and in charging the batteries series or parallel connections may be used. The armature core of these machines are 520 mm. in diameter and the width 360 mm. The slots in the armature are 116 in number with a section 6.5 x 2.4 mm.

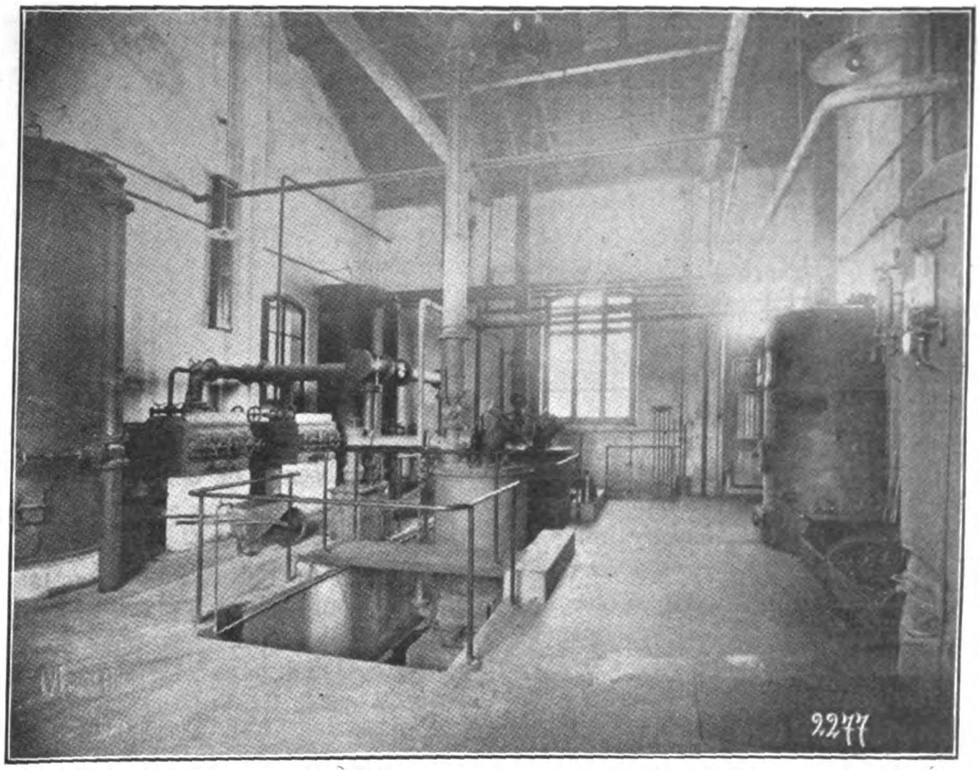

Fig. 3.—Gas Generating Plant at Uster Power House.

Each slot carries two conductors of 4.7 x 5.2 mm. in diameter. Each commutator has 116 segments of pure copper insulated with mica .6 mm. in thickness. The field magnet consists of four coils connected in series, each coil having 968 turns in 16 layers, the conductors being 2.2 x 2.6 mm. in diameter.

The storage battery plant consists of two sets of accumulators, each consisting of 70 cells with a capacity of 800 ampere hours. The light and power distribution circuits are installed on the three-wire system of 250 volts pressure. The motors are operated upon the 250 volt circuits and the lighting service upon the 125 volt. There are several thousand incandescent lights now in operation at Uster of more than 30,000 cp., while the streets are lighted by arc lamps of 9 amperes each. The motor service is quite extensive, from one to five motors being employed in each of the various factories, ranging in power from 1 to 20 hp., the total being in the neighborhood of 140 hp. The accompany- illustration, Fig. 4, shows a 20 hp. motor at Uster driving file machinery in one of the shops.

The charges for incandescent lamps are 1.2 centimes per hour for 5 cp. incandescent lamp, 2 centimes per hour for a 10 cp. lamp, 3.2 centimes per hour for a 16 cp. lamp. and 5 centimes per hour for a 25 cp. lamp, while the yearly rate is 8 francs, 16 francs, 25 francs and 40 francs respectively. The motor rates are 15 centimes per effective horse power hour with a discount ranging from 1 per cent. to 20 per cent. as the size of the motors increase from 9 kw. to 18 kw.

COLLAPSING PRESSURE OF TUBES AND FLUES.

ARTICLE I.

BY W. H. WAKEMAN.

Pressure applied to the internal surface of a boiler shell tends to force it into a true circle (provided it is not already perfect), which is its strongest form, but the same pressure brought to bear on the external surface of a tube or a flue tends to crush or collapse it, and any deviation from true circular form constitutes a weak spot, because external pressure results in an enlargement of the deformity, if the safe limit is exceeded.

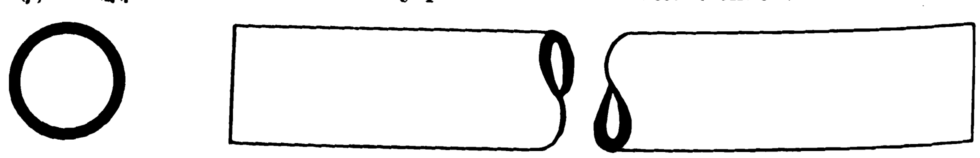

Fig. 1.

The collapse of a large flue is about as dangerous as the bursting of a boiler shell, therefore rules for determining the safe working pressure of the former are as important as for the latter, but they have not received due attention from those who present matter for the consideration of engineers and others interested in steam engineering.

The form of the first flue to be considered is illustrated in Fig. 1. It is of the plain lap welded type having neither riveted seam nor reinforcing ring. Fairbairn's formula for determining the collapsing pressure of this flue has for many years been accepted by the engineering public as a basis for calculations to determine the strength of tubes and flues, but this does not necessarily mean that it is to be taken without modification for all conditions, as it is not elastic enough to meet every requirement of modern practice.

It is introduced here for comment and comparison:

$$9{,}675{,}600 \times \frac{T^2}{L \times D} = P.$$

T = thickness of flue in decimals of an inch.
L = length of flue in inches.
D = diameter of flue in inches.
P = collapsing pressure in pounds.

This formula has been applied to tubes and flues from 3 to 40 inches in diameter, all 16 feet or 192 inches long, and the value of P is as follows:

3	inch tube	.109	inch thick,	199.5	pounds.
4	" "	.134	" "	225.4	"
6	" flue	.165	" "	228.3	"
12	" "	.229	" "	220.2	"
20	" "	.32	" "	257.3	"
40	" "	.5	" "	314.9	"

If we accept the above as correct and use 5 as a factor of safety the safe working pressure will be much less than we carry on at least some of them every day, and this would account for failure of tubes and flues, but there are several reasons why these results should be modified, one of which is that tubes seldom fail in practice even when very high pressures are carried, because their small diameter affords less chance for sudden collapse.

Another reason is that the formula decreases the pressure directly as the increase in length, and of course raises it directly as the length decreases. It is true that Fairbairn found that as the length of a flue increased its collapsing pressure decreased, but we have no proof that it was in direct proportion to the length.

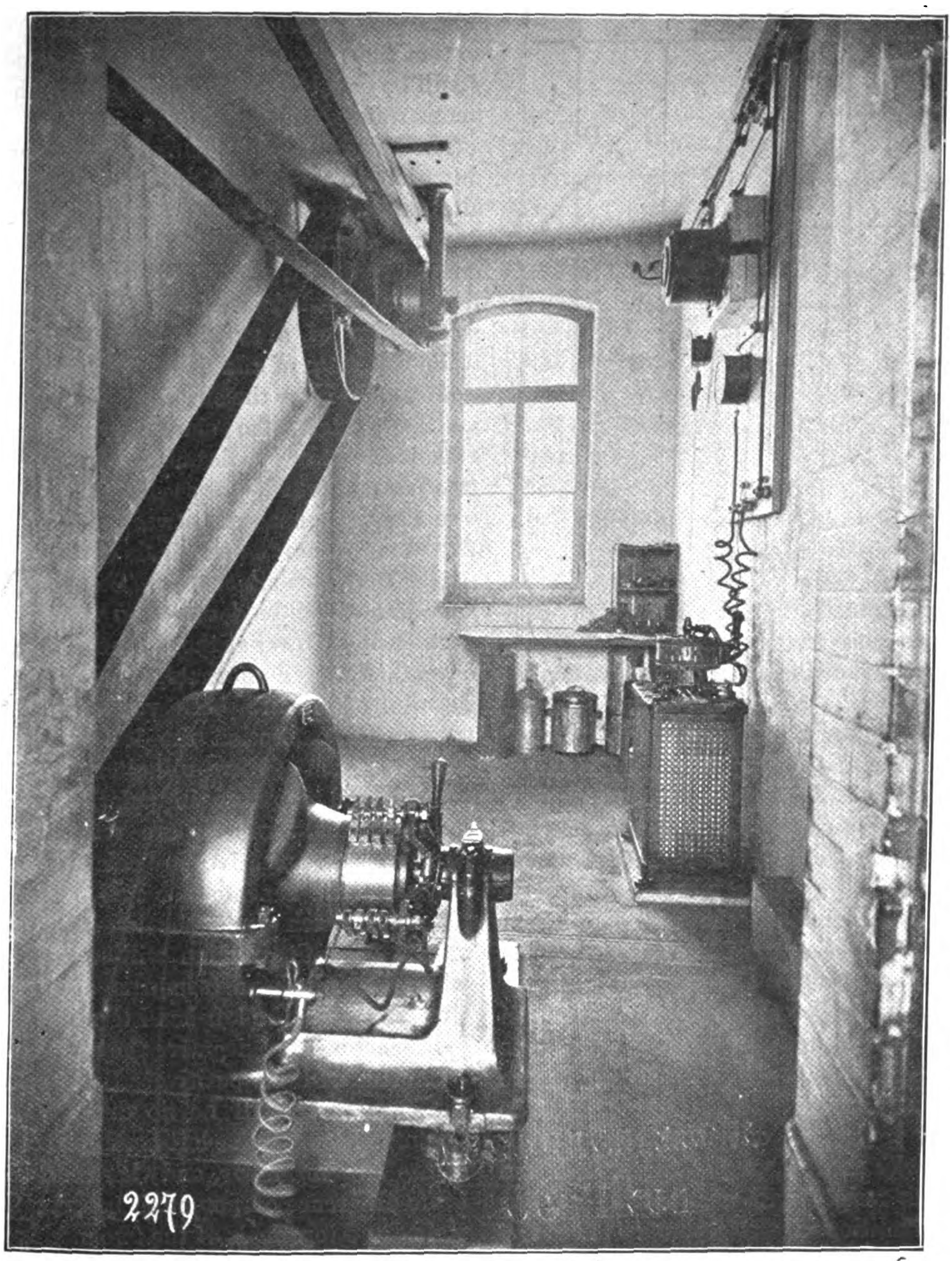

Fig. 4.—Twenty HP. Electric Motor Operating File Machinery at Uster, Switzerland.

This idea has been accepted as correct in some quarters, but not universally.

Applying this formula to a 3 inch tube 4 feet long gives the following result:

$$9,675,600 \times \frac{.109^2}{48 \times 3} = 798.2 \text{ pounds.}$$

It is doubtful if a tube 4 feet long will stand very much more pressure than one 16 feet long, and it certainly will not stand four times as much.

Nystrom drew his own conclusions from Fairbairn's experiments (not from his formula), and gives us the following by which to determine the collapsing pressure:

$$\frac{4 \times T \times t^2}{D \times \sqrt{L}} = P.$$

T = tensile strength of material in pounds.
t = thickness in decimals of an inch.
D = diameter in inches.
L = length in feet.
P = collapsing pressure in pounds.

Taking the value of T at 50,000 pounds and applying this formula to the tubes and flues already used for illustration gives the following result:

3 inch tube	.109 inch thick,	198	pounds.
4 " "	.134 " "	224.4	"
6 " flue	.165 " "	227	"
12 " "	.229 " "	218.5	"
20 " "	.32 " "	256	"
40 " "	.5 " "	312.5	"

The result secured by use of these two formulas, applied to tubes and flues 16 feet long, are practically the same, but when applied to short tubes the difference is plain.

Taking the 3 inch tube 4 feet long, already referred to, this is the value of P:

$$\frac{4 \times 50,000 \times .109^2}{3 \times \sqrt{4}} = \frac{2,376}{6} = 396 \text{ pounds.}$$

As this is just twice the collapsing pressure given for the tube 16 feet long it is a logical conclusion, or at least it is more reasonable than the result secured by the first formula.

Application of it to all the tubes and flues mentioned will show more clearly the difference.

If the reader wishes to take the length of tube or flue in inches and assume 50,000 pounds as the uniform tensile strength of material the following formula may be used:

$$692,800 \times \frac{t^2}{d \times \sqrt{L}} = P.$$

t = thickness in decimals of an inch.
d = diameter in inches.
L = length in inches.
P = collapsing pressure.

It will be noted that in the two preceding formulas the pressure increases or decreases, not directly as the length, but as the square root of the length in feet or inches.

This appears in the light of an improvement, nevertheless all three of the foregoing reduce the pressure indefinitely as the length is increased, which it is difficult to prove correct, because experiments will not sustain the idea. Perhaps this view of the case is unnecessary, as the authors of the formulas intended them for application to lengths commonly found in practice.

As a further illustration of the fact that men do not always arrive at the same conclusion, even when the basis of their knowledge on a subject is common to all, the following formula is introduced. It is given by another engineer who has been studying Fairbairn's experiments:

$$\left(5,358,150 \times \frac{t^2}{L \times D}\right) + 41,906 \times \frac{t^2}{D}\Bigg)$$
$$\pm\left(1,323 \times \frac{t}{D}\right) = P$$

t = thickness in decimals of an inch.
L = length in inches.
D = diameter in inches.
P = collapsing pressure in pounds.

For the purpose of intelligent comparison this formula has been applied to the same examples that were used to illustrate those previously given with the following result:

3 inch	tube	.109 inch	thick,	314	pounds.
4 "	"	.134 "	"	247.7	"
6 "	flue	.165 "	"	352.3	"
12 "	"	.229 "	"	329.8	"
20 "	"	.32 "	"	378.2	"
40 "	"	.5 "	"	452.5	"

It will be noted that these results are decidedly higher than those previously given.

ELECTRICAL STATION PRACTICE.

ARTICLE XIX.

BY W. H. RADCLIFFE.

The operation of an alternator when run singly differs but little from that for a direct current generator. As to the preliminaries, the field exciter must first be started, and for this the directions previously given for starting up a self-excited shunt-wound direct current generator should be followed. At first but a small current should be sent through the field winding of the alternator; then, if the exciter operates satisfactorily and the field magnetism of the alternator shows up well, the load may gradually be thrown on this latter machine until the normal current is carried, the same method of procedure being followed as in the similar case of a direct current generator.

When load is thrown on an alternator there is a noticeable drop in voltage across its terminals. This is caused in part by the demagnetization of the field magnets due to the armature current, and so depends in a measure upon the position and form of the pole pieces as well as those of the teeth in the armature core. The resistance of the armature winding also causes a drop in voltage under an increase of load, which is equal in volts to the product of the resistance of the winding in ohms multiplied by the strength of the armature current in amperes. Yet another cause may be mentioned for the failure of the alternator to maintain its voltage with an increase of load, and this is the inductance of the armature winding, which is in turn due to the positions of the armature coils with respect to each other and also with respect to the field magnets.

When the load on a station increases beyond that which can conveniently be carried by one alternator it becomes necessary to connect other alternators in parallel with it. To properly introduce a new machine in parallel with one already in operation and carrying load, requires a complete knowledge of the situation on the part of the attendant. It may also be added that there is required some experience in this direction, but when knowledge of the situation is grasped the battle is considerably over half won. The case is presented diagrammatically in Fig. 20.

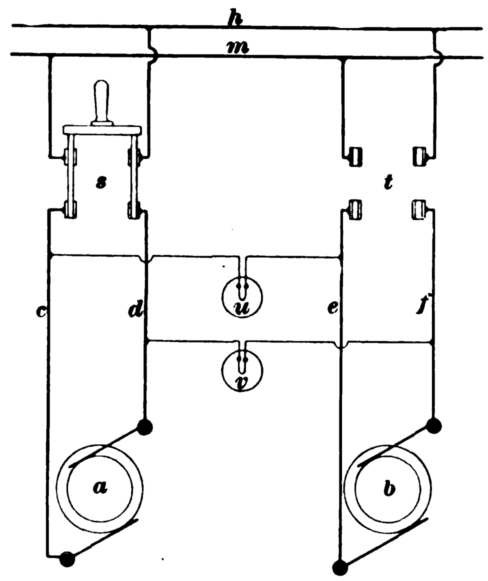

FIG. 20.

In this illustration the alternator *a* is in operation and is supplying current through the mains *c* and *d* and the double pole switch *s*, to the bus bars *h* and *m*. The alternator *b*, on the other hand, is laying idle, not having as yet been called into service. The double pole switch *t* by means of which this machine can be connected into circuit is therefore open. Suppose, now, that an increase of load on the station justifies the introduction of the machine *b* in parallel with the machine *a*. In order that *a* and *b* operate well in parallel, it is necessary that they conform to each other in three respects. The three conditions should also be satisfied before they are thrown together by closing the switch *t*, else the one alternator will be short-circuited through the other and serious results will undoubtedly follow. The conditions are as follows: The frequency developed in each of the two alternators must be the same; the speeds of the machines must also be equal; and the two alternators must be in phase, or as it is sometimes termed, in step or in synchronism with each other.

To satisfy the first of these conditions it is necessary to start up the alternator *b* and regulate its speed in revolutions per second so that the number representing this quantity when multiplied by the number of pairs of poles it contains will be equal to the speed in revolutions per second of the alternator *a* multiplied by the number of pairs of poles on *a*. When such is the case, the frequency in cycles per second of each machine will be the same, since the frequency is always equal to the product of the number of pairs of poles by the speed in revolutions per second. Then, with the speed of alternator *b* maintained constant at the value found to satisfy the first condition, the second condition imposed must be fulfilled by regulating the field current of *b* so that the voltage across the mains *e* and *f* will be equal to the voltage across the mains *c* and *d*.

The third condition, namely, the determination of the instant at which the two alternators are in phase with each other, is a much more difficult proposition to encounter than the other two. The solution of the problem consists in employing some form of a synchronizer to show when this state of affairs occurs, and when therefore to close the switch *t*. For a low voltage system, the simplest and most effective form of synchronizer consists of two incandescent lamps as shown at *u* and *v* in Fig. 20 connected between the mains that extend from the terminals of the same polarity on each alternator. The lamps *u* and *v* must each be designed to supply its rated candle power at the normal voltage developed by the alternators. Now since the alternators are both running under normal field excitation the left-hand terminals of each of them will alternately be positive and negative in polarity, while the right-hand terminals are respectively negative and positive in polarity. If, however, the machines *a* and *b* are in phase with each other, the left-hand terminals of both of them will be positive while the right-hand terminals are negative, and when the left-hand terminals of both machines are negative the right-hand terminals will be positive. Such being the case, there will be no difference of potential between the left-hand terminals of the two machines, and there will also be no difference of potential between the right-hand terminals of the two machines.

If, therefore, incandescent lamps be connected as shown in Fig. 20, one between the left-hand terminals of the alternators and one between the right-hand terminals, neither of these lamps will be lighted when the machines are in phase. The instant there is a difference of phase between the alternators, however, there will be a difference of potential between the terminals of the same polarity on the machines and the lamps *u* and *v* will both light, attaining full candle power when the difference of phase has reached a maximum, since then the full potential of each machine will be supplied to the

lamps. A very slight change in speed will soon shift forward the phase of the one alternator relatively to the other, lowering in consequence the difference of potential between the terminals of like polarity, and causing both the lamps to give a bright red glow. As the alternators continue to come closer in step, the red glow will gradually fade away until the lamps become dark. Then the switch *t* may be closed, thereby throwing the two machines in parallel. If the intervals between the successive lighting up of the lamps are of short duration it is advisable to wait until these become longer even though the other conditions are satisfied, because where the phases pass each other rapidly there is a greater possibility of not bringing them together at the proper instant. An interval of not less than five seconds should therefore be allowed between the successive lighting up of the lamps, before closing the switch.

The switch *t* having been closed with no unusual disturbance occurring in the circuits, attention must next be given to equalizing as nearly as possible the loads upon the two machines. This is accomplished by a proper handling of the rheostats in their respective field circuits so as to cut down as far as possible the current passing between the alternators, and which is known as the synchronizing current. The synchronizing current will have a minimum value when the deflections on the ammeters in the main circuits of these respective machines are as small as it is possible to make them without decreasing the voltage developed in the armature of either alternator. When the alternators are once in phase and running smoothly, they will need but little attention, inasmuch as there always exists a strong tendency for them to remain in synchronism with each other.

When the alternators to be switched together in parallel are each designed to produce a high electromotive force, the simple synchronizing device employed in Fig. 20 is inadequate. By the use of two step-down transformers, however, the same principle is applied in a modified form, and is then well adapted to the case in hand. Each of the two transformers must be connected with its primary coil across the terminals of one of the alternators, and the secondary coil of each is joined in series with the other, and these in series with two incandescent lamps. The connections between the secondary coils of the transformers are such that when each is subjected to the same conditions the action of the one coil opposes that of the other, and as the transformers are both of the same design there will consequently be no voltage across the lamps when the alternators are in phase with each other. If the ratio of each transformer is such as to give, for example, 100 volts across its secondary terminals, then the two incandescent lamps since they are joined together in series must each be designed for 100 volts. When, therefore, the alternators are directly opposite in phase to each other, both the lamps will burn brightly; as the alternators come together in phase the lamps will produce less and less light, until when the machines are exactly in phase no light will be emitted at all. Then the unloaded alternator may be switched in parallel with the other, and the same method of procedure followed as described for the similar case in a low voltage system.

If the conditions are of such a nature that the alternators may all be started together, the paralleling of them becomes a simple task. After bringing each of them up to its proper speed so as to obtain equal frequencies, the main switches may be closed, thereby joining their armature circuits in parallel. As yet, however, their respective field windings have not been supplied with current, so that no harm can result in doing this. The exciters of these machines after being joined in multiple should then be made to send direct current simultaneously through the field windings of the alternators, and from this stage on the directions previously given may be followed in detail.

If alternators are directly connected to each other, or to an engine, they must necessarily run in the same manner at all times. If, therefore, the machines when connected in this way are properly adjusted so that they are in phase with each other, their operation in parallel is still a simpler task than when they are all started together but are not directly connected.

When it is desired to cut out of circuit an alternator running in parallel with others, its main circuit should be opened either by means of a switch or circuit breaker, according to which of these is best designed to be used for this purpose with the voltage employed in the system. No attempt should be made to cut down the voltage of the alternator before disconnecting from the others; while this might be done with advantage were the alternator running alone, there would be a tendency in the case of a parallel connection for the alternator or alternators continuing in operation to force a current through the machine in question and thereby cause considerable damage.

Alternators are seldom if ever connected in series, for the reason that the synchronizing tendency previously mentioned as peculiar to these machines causes them to oppose each other, and fall out of phase when they are joined together in this way. If, however, they are directly connected to each other, or to an engine, so that they necessarily keep in phase all times, and thus add their respective electromotive forces instead of counteracting them, it is possible to operate them together in this manner.

INTERURBAN ELECTRIC TRACTION SYSTEMS--A. C. VS. D. C.*

BY P. M. LINCOLN.

Electric traction is peculiarly an American institution, that is, it has found its widest application in American communities and has been developed chiefly by American engineers. In America practically every town of over 5,000 inhabitants is provided with an electric traction system. In other parts of the world it is only larger centers of population that are so provided.

Practically all the traction work in America has been done by direct current. The alternating current traction system, although it has received considerable attention from American engineers, has not until recently been favorably considered by them. In Europe, on the other hand, the alternating current traction problem has received a large amount of attention. The polyphase induction motor has been developed by European engineers for traction purposes and a number of installations have been made in Europe with apparatus of this character. American engineers have consistently refused to adopt the polyphase induction motor for traction purposes on the ground that it is not suitable for that purpose. The principal reasons for this stand are two in number.

1. That the polyphase induction motor is inherently a constant speed motor and, therefore, not adapted to traction purposes. Continual change of speed is one of the characteristics of traction work. The direct current series motor is peculiarly adapted to this class of work because it is inherently a variable speed motor. At one definite speed the polyphase motor is an efficient machine, while at all other speeds the efficiency cannot be greater than the ratio of the actual speed

*Abstract of paper read before the Electrical Section of the Canadian Society of Civil Engineers, Nov. 19, 1903.

to the synchronous speed. For instance, if the actual speed at which a given induction motor is working is 10 per cent. of its synchronous speed, the power utilized is at most only 10 per cent. of the power put in. In traction work a large part of the work done is necessarily at speeds below the maximum attained, and at these lower speeds the maximum economy that can be obtained from induction motors is necessarily small.

One expedient used by European engineers is to reduce this source of loss is the use of motors in concatenation or in tandem, that is, the secondary of one motor is fed into the primary of another on the same car. If the pair of motors thus concatenated are wound for the same number of poles, this expedient has the effect of making the synchronous speed of each of the pair of concatenated motors one-half that which it is when not in concatenation. It is equivalent in direct current practice to throwing two shunt motors in series. Up to the half speed joint, therefore, there is a gain of economy by this arrangement. By winding the two concatenated motors for different numbers of poles more than one point of maximum economy can be secured between zero speed and full speed, but this arrangement has the disadvantage of being able to use but one-half the total motor capacity above half speed while the greatest expenditure of energy takes place above half speed. In order to secure the advantages of concatenation, however, it is necessary to add largely to the weight of the electrical apparatus. European practice has been to equip cars with four motors, two main motors and the other two being used only while the car is below half speed. Above half speed the motors are running idle and are doing no useful work. The energy required to take care of the additional weight is an offset against the energy which is saved by concatenating the motors. For long runs this expedient would probably be detrimental since the energy taken up to transport the extra weight would be more than equivalent to the energy saved at the start.

2. The second reason against the use of polyphase induction motors for traction purposes is the necessity for providing at least two overhead conductors. If the track be not used as one of the conductors, then the necessity arises of using at least three overhead conductors. Maintenance of insulation on such overhead conductors when they are at high voltage is naturally a difficult problem, much more difficult than to maintain the insulation between a single conductor and ground, as would be the case in a single-phase system.

American engineers instead of endeavoring to adapt the unsuitable induction motor to traction purposes, have devoted their energies to the development of a suitable alternating-current motor. The idea of using a series motor operated by alternating current is not new. The only alternating current single phase motors which have a characteristic suitable for electric traction purposes are those of the commutator type. In no other type of motor are the speed and torque characteristics such as to be suitable for traction purposes. In the commutator type alternating current motor, the speed and torque characteristics are practically identical with these characteristics in the direct current series motor. As early as 1893 extensive experiments were made by the Westinghouse Electric & Manufacturing Company on this class of motors. In fact, the experiments went so far as to equip a car with two motors of this type and the car was put into actual operation. Moreover, the frequency and voltage for which the motors were designed was practically the same as those for which the more recent motors were designed. These early motors were considerably smaller in capacity, however, and the trolley voltage was less. Further, the method of controlling the speed was by control of voltage. Although the early motors were successful as motors, the alternating current system as a system was not thought at that time of sufficient importance to continue the developments along this line. In other words, the time was not yet ripe for the development of this system. Interurban electric traction work, such as exists to-day, was not at that time thought of, and this is, in the writer's opinion, the peculiar field for the alternating current traction system.

In considering the general problem of electric traction, the question naturally arises—what is gained by the use of alternating current over direct current? and the converse of this question also naturally arises—what is it necessary to sacrifice in order to obtain the benefit of alternating current traction? An analysis of the advantages and disadvantages of these two systems may be of interest. Although many of the following points have been treated in previous papers, particularly that of Mr. Lamme, acting chief engineer of the Westinghouse Electric & Manufacturing Company, before the American Institute of Electrical Engineers in September, 1902, it is hoped that repetition of some of the points mentioned will not be out of order.

The principal advantages of the alternating current electric traction over the direct current are as follows:

1. Limits to trolley voltage are removed.

2. Avoidance of rheostatic losses.

3. The necessity for rotary converter sub-stations abolished.

4. Manual attendance at the sub-stations done away with.

5. Danger of electrolysis by return current avoided.

To take up these points more in detail:

1. Voltage Limit Removed.—The greatest item of cost in the electrical equipment of interurban traction systems as they exist to-day is that of secondary distribution. This item of cost usually carries somewhere between 25 and 50 per cent. of the total for electrical equipment and is usually much nearer the latter figure than the former. Six hundred volts at the motor in a direct current traction system is practically the limit at which present designers and manufacturers are willing to guarantee their operation except in some special cases. This necessarily limits the voltage fed into the secondary distribution system to, say, 700 as a maximum. The consequence of this comparatively low voltage is naturally a high cost for conductors of this secondary distribution. The alternating current system, providing as it does the possibility of greatly increasing the voltage of the distributing system, thus cuts down largely the cost of this distributing system.

Another point which militates against the use of direct current is that when large units are used it is difficult to collect the large amount of current for their operation. For this reason, as well as an advantage in cost, trolley construction has been largely replaced by the third rail for interurban work. By raising the voltage of the secondary system the current taken by a locomotive may be reduced, and consequently the difficulty with collecting devices may be made to disappear.

2. Rheostatic Losses Avoided.—In the direct current system the voltage at the car is practically constant, and while the counter EMF. of the motors is building up the excess voltage must be taken up by resistance. At the start, therefore, a large rheostatic loss occurs. With the alternating current system, on the other hand, the voltage at the car may be controlled by suitable means and the rheostatic loss thus avoided. When stops are few, and consequently runs are long, the

rheostatic loss in the direct current system is a small proportion of the total, and, therefore, under these conditions this advantage of the alternating current system is not so greatly marked. With short runs, on the other hand, and consequently frequent starts, the rheostatic loss with the direct current system amounts to a considerably greater proportion of the total loss and the alternating current system, therefore, can have the greater advantage.

3. Necessity for Rotary Converters Avoided.—The cost of sub-station equipment constitutes one of the large items in the cost of the electrical equipment of an interurban road. In this sub-station equipment by far the largest item of cost is the rotary converters. In the alternating current equipment the rotary converter has no place, thus avoiding not only a large item of cost but also one of the largest items of the loss of power.

(To be continued.)

Electro-Capillary Recorder.

A dispatch from London states that Armstrong & Orting, inventors of the wireless telephone, have invented an instrument they call an electro-capillary recorder. Cables are enabled to receive from 400 to 500 letters a minute. The arrangement seems indifferent to leakages and faulty cables.

Looking for a Factory Site.

The stockholders of the Otto Gas Engine Works, which is located at 33d and Walnut streets, Philadelphia, Pa., have decided to increase the capital of the corporation from $600,000 to $2,500,000, and build a large new plant just as soon as the management can find a suitable site for the purpose. Large gas engines, producer gas plants, launches and marine engine, gasoline hoists, compressors and other adaptations of the gas engine will be built at the new plant. A suitable site must contain not less than 30 acres, must be located on a good water front and must have good railroad facilities.

Proposals Invited.

Sealed bids will be received by the board of public works of Jamestown, N. Y., consisting of P. H. Hoyt, Samuel A. Cralson and W. I. Bylstone, until January 15 for the following: One 350 hp. compound condensing engine, one 200 hp. alternating single-phase, 60 cycle, 1,100 volt dynamo, and one 200 hp. turbo-generator set.

Northwestern Electrical Association Convention.

Following is the programme of the twelfth annual convention of the Northwestern Electrical Association to be held at the Hotel Pfister, Milwaukee, Wis., Wednesday, Thursday and Friday, January 20, 21 and 22:

Wednesday, morning session—Convene at 11:30. Roll call, reading of minutes, president's address, secretary and treasurer's report.

Afternoon session—Appointment of nominating and membership committees, applications for membership, reports of all committees except nominating, miscellaneous business. Papers: "Storage Batteries for Central Station Work," J. M. S. Waring; "Peculiarities of Magnets," Richard Varley; "Rectifiers," W. Scheidel.

Evening—Theater party.

Thursday, morning session—Papers: "Double Current Generators in Their Connection with Double Current Supply," W. L. Waters; "Central Station Heating," W. H. Schott; "Standard Practice in the Use of Alternating Current Electrical Apparatus," J. J. Gibson.

Afternoon session—Report of nominating committee and election of officers. Papers: "Steam Turbines" (illustrated), James Lyman; "Rectifiers," Prof. B. F. Burgess; illustrated lecture on radium, Prof. R. A. Milliken.

Evening—Annual banquet.

Friday morning—Unfinished business. Adjournment.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JANUARY 5, 1904.

Electric Railways and Appliances.

748,591. Third-Rail Cover. Henry F. Duffy, Seattle, Wash. Filed June 20, 1903.

748,592. Third-Rail Protector. Henry F. Duffy, Seattle, Wash. Filed June 20, 1903.

748,619-748,620. Electric Railway. Charles J. Kintner, New York City. Filed Sept. 22, 1899, and March 10, 1902. Renewed May 19, 1902, and May 22, 1903.

748,621. Safety System of Electric Railways. Charles J. Kintner, New York City. Filed Nov. 15, 1902.

748,810. Electric-Car Plow. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Filed March 30, 1903.

748,815. Railway Block-Signal and Switch. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Filed March 30, 1903.

748,872. Electric-Railway System. William G. Lowrie, New York City. Filed June 21, 1901.

748,987. Trolley-Harp. Edward D. Rockwell, Bristol, Conn. Filed Nov. 7, 1903.

749,042. Electric-Railway System. William M. Eader, Middletown, Md. Filed July 27, 1903.

Electric Lights and Appliances.

748,574. Apparatus for Producing Electric Arcs for Heating and Lighting Purposes. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Filed June 22, 1903.

748,599. Incandescent-Electric-Lamp Socket. Henry A. Framburg, Chicago, Ill. Filed April 9, 1903.

748,904. Electric-Arc Lamp. Luis Wirtz and Thomas Hamilton-Adams, London, Eng. Filed Feb. 4, 1903.

748,915-749,016-17-18. Electric-Arc Lamp. Edward H. Belden, Fort Wayne, Ind., assignor to the Westinghouse Electric & Manufacturing Company. Filed first Aug. 6, 1900; all renewed May 11, 1903.

Electrical Machinery and Apparatus.

748,572. Apparatus for Controlling Current-Supply to Electrically-Heated Tools. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Filed June 1, 1903.

748,573. Electrically-Heated Tool. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Filed June 15 1903.

748,635. Automatic Brake for Controlling Switches of Electric Motors. Frederick A. Muschenheim and William F. Hendry, New York City, assignor to the Western Electric Company. Filed June 2, 1902.

748,638. Electric-Circuit Closer and Breaker. Thomas H. McQuown, Biggsville, Ill. Original application filed Sept. 26, 1902. Divided and this application filed Jan. 5, 1903.

748,639. Fuse for Electric Circuits. Theodore Nagel, Chicago, Ill., assignor of one-half to Lathrop H. Collins, same place. Filed April 24, 1903.

748,771. Electrically-Driven Centrifugal Machine. Henry G. Morris, Philadelphia, Pa. Filed May 8, 1903.

748,812. Switch-Throwing Mechanism. William F. Taylor, Jr., Providence, R. I., assignor of one half to Thomas D. Taylor, Boston, Mass. Filed March 30, 1903.

748,813. Contact-Shoe. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Filed March 30, 1903.

748,814. Semaphore Mechanism. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thos. C. Taylor, Boston, Mass. Filed March 30, 1903.

748,906. Transmitter. Ernest E. Yaxley, Chicago, Ill., assignor to the American Electric Telephone Company, same place. Filed April 13, 1901.

748,907. Electric Dynamo or Motor with Alternating Field. Rudolf Ziegenberg, Schoneberg, Germany. Filed April 25, 1903.

748,961. Electric Coupling. George A. Le Fevre, New York City. Filed Jan. 28, 1903.

749,085. Electrical Cut-out. Columbus B. McPherson, Birmingham, Ill. Filed Nov. 14, 1902.

Telephones and Telephone Apparatus.

748,690. Telephone-Transmitter. Charles F. Bennett, Waterloo, Ia. Filed Nov. 29, 1901.

748,716. Wire-Connector. James S. Ford, Chicago, Ill., assignor to the American Telephone & Telegraph Company. Filed Oct. 9, 1903.

748,980. Telephone-Exchange. Nils E. Norstrom, Chicago, Ill., assignor of two-thirds to John Anderson, Salina, Kan., and M. E. Richardson, Sterling, Kan. Filed March 16, 1901.

Miscellaneous.

748,571. Electric Soldering-Iron. James I. Ayer, Cambridgeport, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Filed Nov. 13, 1902.

748,597. Wireless Signaling Device. Lee De Forest, New York City. Filed Dec. 24, 1902.

748,609. Production of Hydroxids and Oxids of Metals by Electrolysis. Frederick F. Hunt, New Brighton, N. Y., assignor of two-thirds to Maas & Waldstein, New York City. Filed Jan. 22, 1903.

748,749. Electrical System of Heating. Edward H. Kitfield, Swampscott, Mass. Filed Oct. 26, 1903.

748,824. Block-Signal System. Joseph Weatherby, Jr., Wilmington, Del. Filed July 24, 1902.

748,940. Method of Producing Electrodes for Storage Batteries. Frederick A. Feldkamp, Newark, N. J., assignor to the Electra Manufacturing Company. Filed April 17, 1903.

748,941. Electric Signal System. Howard A. Fessenden, Detroit, Mich., assignor to the Detroit Electric Signal Company. Filed Dec. 16, 1901.

748,970. Automatic Signaling Apparatus. Ira A. Michael, Chicago, Ill., assignor of one-half to John H. Reynolds, Troy, N. Y. Filed June 27, 1902.

749,033. Telegraphic Receiving Apparatus. Frederick G. Creed, Lenzie, Scotland, assignor to himself, and William Arthur Coulson, Glasgow, Scotland. Filed Aug. 9, 1902.

749,105. Electric Signal. Baptist H. Scott, Allegheny, Pa. Filed Jan. 20, 1903.

749,131. Wireless-Signaling Apparatus. Lee De Forest, New York City, assignor to the Wireless Telegraph Company of America. Original application filed March 6, 1901. Divided and this application filed Dec. 8, 1902.

THE TELEPHONE WORLD.

Bell People Losing Prestige in Bureau County, Ill.

The Central Union Telephone Company, known as the Bell Trust, is said to be losing its hold rapidly in Bureau County. Several years ago it had about 70 telephones in use in Princeton. Now it has about a dozen and in a vacant store room is piled up dozens of discarded instruments. The Central Union has no longer any service between Princeton and Tiskilwa. The business gradually dwindled down, and a few weeks ago the poles along the highway between the two towns were chopped down. The company had a toll station at Dover, but has been requested to remove it. It is claimed there was only about 20 cents worth of business done the last month and that it does not pay to bother with it. Here are some of the towns in Bureau County which the Trust cannot call up: Tiskilwa, Dover, Walnut, Kasbeer and New Bedford. The Princeton city council passed an order giving the company 60 days in which to remove the unused poles and wires and directed the superintendent of streets at the end of that time to chop down the poles, if the company has not complied with that order.

President C. A. Barron, of the Skagit Farmers' Mutual Telephone Company, has lately been in Everett, Wash., and announced that in a few weeks his company would make application for a franchise for an Independent telephone company in Everett, to connect with the services already established in 18 towns in Snohomish and Skagit Counties, and with the Independent Telephone Company at Seattle. This company has just secured a franchise at Arlington and expects to have its system operating there within 30 days. It is building a line from Silvania to Marysville, a few miles from Everett. B. H. Vollans, formerly manager of the Sunset Company in Everett has associated himself with the Independent concern.

The Independent Telephone Company of Le Mars, Ia., which is operating an exchange in opposition to the Iowa Telephone Company, has filed articles of incorporation with the Secretary of State for a new company. The capital stock of the new company will be $25,000. A. C. Colledge is president and I. S. Mahan is secretary.

The Missouri & Kansas Telephone Company completed the work of installing a long distance line into Waco, Kan., a short time ago. An exchange has been placed in that town, which is also connected with private lines running from the homes of many farmers in that vicinity.

The Georgia Railway & Electric Company, of Atlanta, has just completed a telephone system by which the cars are directed when trouble arises or a wreck occurs.

It is reported that a telephone line will be constructed through Brownsburg, Pa., along the main river drive, in the near future.

The Elyria, O., Telephone Company has increased its capital stock from $50,000, to $100,000.

Three Telephone Companies' Earnings.

News from St. Paul, Minn., states that three telephone companies lately filed reports of their gross earnings with the State Auditor. The Northwestern Telephone Company stated that the earnings of the company in Minnesota had been $902,802.30 for the year. This sum is subject to a tax of 3 per cent., making a sum of $27,084.07 for the State Treasury. The Minnesota Telephone Company earned $4,796.77 last year, making its contribution to the State $143.90 The Shakopee Telephone Company made $2,186.70, and will pay a tax of $65.60.

Weather Forecasts by Telephone.

The Colorado Telephone Company, at Denver, has established the system of telephoning the weather forecasts to its patrons. About 240 Colorado towns and the farmers living near them receive daily reports. The system also extends to New Mexico, where 17 cities are given a daily report.

Arrangements have also been made to enable the Indianapolis weather bureau to announce the weather forecast each day at 10 o'clock to the residents of the extreme part of Northern Indiana. The plan is to telephone the report to Lagrange, Shipshewana, Millersburg and Middlebury, from which centers it will be distributed to all telephone patrons at the hour named. A similar service has long been in use in Central and Eastern Indiana.

The Home Telephone Company has added many customers to its lists in Waterloo and Seneca Falls, N. Y., and has now secured the right of way between Waterloo and Geneva, and is soon to commence the erecting of the poles and the stringing of the wires to that city. The company has arranged to connect there with the local line of Waterloo and will thus be placed in direct communication with the western part of the State as far as Buffalo, a connection that will be of great advantage in Waterloo.

The Kensington Telephone Company, at Kensington, Md., has been organized with the following officers: President, Byron A. Chapin; vice-president, Eugene Jones; secretary, George R. Taylor; treasurer, C. E. Bruington. It is proposed to institute local service at the start and expand as occasion demands.

The Keystone Telephone Company of Philadelphia, Pa., has reported its net earnings for the calendar year ended December 31, 1903, as $230,548, or twice the amount required to pay a 5 per cent. dividend on the $2,500,000 preferred stock.

The Sunset Telephone Company has found it necessary to construct a new line from San Diego to Corona, Cal., 100 miles distant. The line has been completed as far as Pala, 45 miles south of Corona.

The Oneonta, N. Y., telephone exchange now has 1,000 subscribers. A new switchboard has lately been installed.

The New York Telephone Company has opened a new telephone exchange at 350 West 17th street, known as the Chelsea.

Uses One Wire for Telephone and Telegraph.

H. C. Todd, of Maryville, Mo., manager of the Hanamo Telephone Company, has perfected an apparatus by which it is claimed that an ordinary telephone wire can be used for both telephone and telegraph service purposes at the same time. He has confined his operations to a long-distance wire extending from Maryville to St. Joseph. His experiment has proved practical, and for two days the line has been doing the double work.

The Hilton, N. Y., Telephone Company, owned and operated by a number of the citizens of the town of Hilton, has had a remarkably successful year. The company was organized a little over a year ago by several enterprising business men of the town, who felt that Hilton should be provided with adequate telephone facilities. Business was begun with only 22 subscribers. Many new 'phones were soon installed, until now nearly every residence and store in Hilton is provided with its telephone. Lines have been run out into the country and numerous farmers have availed themselves of the opportunity to establish telephone connections with the village. The Hilton Company has offices at Parma Center and Parma Corners.

The Madison County Gas & Electric Company has purchased part of the poles and wires of the Oneida, N. Y., Telephone Company, and the work of dismantling the poles down town has been commenced. The rest of the poles of the Oneida Company have been purchased by the Central New York Telephone & Telegraph Company.

Within a short time Lincoln, Neb., will be equipped with one of the most modern telephone exchanges in the world. The Nebraska Telephone Company will install in its Lincoln office improvements costing more than $100,000, principal of which is a $55,000 central energy switchboard with a capacity of nearly 10,000 telephones.

Lima, O., business men are said to have purchased the controlling interest in the Lima Telephone Company, which was owned by the Federal Company. The negotiations have been put through by F. S. Dickson, of the Federal Company.

At a recent meeting of the stockholders of the Warwick Valley Telephone Company at Middletown, N. Y., another semi-annual dividend of 2¼ per cent. was ordered paid to stockholders.

The Maple Valley Telephone Company of Iowa will expend $2,000 in improvements and extensions.

Telephone Incorporations.

The Beekmantown Telephone Company, Clinton County, Beekmantown, N. Y. Capital stock, $1,000. Directors: David Chellis, of Point Au Roche; George Deloria and W. P. Walker, Beekmantown.

The Masonville Telephone Company, Masonville, N. Y. Capital stock, $3,500. Directors: D. O. Smith, W. E. Bogart and H. S. McKinnon of Masonville.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Buffalo, N. Y.—The trustees of this city and County Hall have asked the county supervisors for the installation of an electric lighting plant.

Camden, N. Y.—This town is to set up an electric light plant of its own; $40,000 bonds have been issued to establish a plant.

Canton, Mo.—State Auditor Albert O. Allen, recently registered $10,000 worth of electric light bonds for this city.

Charlestown, Ind.—Mayor E. T. Runyon states that the contract for building a $6,000 electric plant here has been let to C. R. Hay, and the city has given him a 10-year contract for light.

Chillicothe, Mo.—The Merchants' Electric Light Company has raised nearly $25,000 for installing its plant.

Clifton Springs, N. Y.—This village is contemplating building an electric light plant.

Comanche, I. T.—The Comanche Electric Company is in the market for wire, insulators, cross arms, pins, etc., for the electric light plant. Address W. M. Diehl.

Downey, Cal.—A company in which A. L. Ball, T. R. Crawford and others are interested will erect a new electric light plant.

Elmer, N. J.—The Foran Electric Light Company, which has a franchise here, has asked the council to take action on the location of its plant in the borough.

Fort Branch, Ind.—The town board will soon grant a franchise for electric lights to Polk & Genung.

Frederic, Mich.—This town is to have an electric light plant soon.

Laconia, N. H.—The Laconia Electric Lighting Company has increased its capital stock from $45,000 to $60,000.

Meadville, Mo.—The question of an electric lighting plant is being agitated here.

Modesto, Cal.—Charles Tulloch, manager of the Stanilaus Milling & Power Company, states that just as soon as a franchise is granted for an electric lighting and power system in this city, active work will begin on the construction.

Monongahela, Pa.—The council has been considering an offer of Spencer Brothers to build an electric light plant here.

Newtown, Pa.—This village is to have electric lights in the near future.

Penn Yan, N. Y.—The village electric light committee will secure figures on cost of dynamos and other machinery and improvements for the electric light service.

Pinconning, Mich.—The common council has taken action toward procuring an electric light plant.

Rockingham, N. C.—Arrangements are reported to be under way for the establishment of a 25,000 hp. electric plant here. Alex. Page is said to be interested.

Sonestown, Pa.—The citizens of this town and Muncy Valley are trying to secure electric lights for their villages.

St. Peter, Minn.—M. B. Johnson & Co. are to install a dynamo in their factory for power and electric lighting purposes.

Sturgeon Bay, Wis.—The city council has purchased the electric lighting plant from Adolph Hamacek for $19,000.

Tamms, Ill.—The Illinois Milling & Elevator Company, incorporated with a capital of $50,000, will do milling, and furnish electric light and power. Oscar T. Tamms, Joseph Mayer, Jr., and others are interested in the concern.

Troy, O.—The Western Ohio Traction line has made a proposition to the people of Sidney to furnish power for lighting homes and running machinery.

Vicksburg, Miss.—The Vicksburg Railway & Light Company, of which S. S. Bullis is president, will increase its lighting capacity, but has reached no definite decision yet as to how this shall be done.

Wisner, Neb.—The matter of installing an electric lighting plant here has been revived.

Watertown, Tenn.—Plans are under discussion to erect a new electric light plant here.

STREET RAILWAYS.

Albert Lea, Minn.—The Inter-State Electric Railway Company is planning an electric railway from Central Minnesota.

Altoona, Pa.—A project of Philadelphia capitalists is under way to construct a trolley line from this city to Bedford by way of Loys Gap, where the Bedford Water Power & Electric Company is building one of the largest power plants in this section.

Atlantic City, N. J.—The city council has granted a franchise for a trolley line on Virginia, South Carolina and Adriatic avenues to the Central Passenger Railway Company, which is controlled by local capital. The line is to be built within one year.

Baltimore, Md.—A. J. Carr says he has information to the effect that the proposed electric railway will be built from here to Frederick.

Colorado Springs, Col.—General Manager C. W. Sells of the cog road has announced that Eastern electrical engineers are at work perfecting a new storage battery which is his own invention, and which is to be utilized in electrifying the system next spring or summer. The estimated cost of the installation is $225,000.

Connersville, Ind.—The Ohio & Indiana Traction Company is seeking an entrance to this place.

Findlay, O.—Mayor C. B. Metcalf and Drs. W. W. and W. H. Drake, of this city, and C. M. Bailey, of Toledo, are the incorporators of an electric road to be known as the Lake Erie Traction Company. The capital is $100,000.

Fond du Lac, Wis.—J. P. McMullen, of Chilton, is interested in the building of an electric line from here to Manitowoc.

Frederick, Md.—The Catoctin Electric Railway Company is the name of a new concern being formed here, to build an electric trolley system between this city and Middletown. C. R. Tottlemyer is interested.

Gloversville, N. Y.—The Fonda, Johnstown & Gloversville Railroad Company has purchased the property of the Adirondack Lakes Traction Company, consisting of the trolley line leading from Gloversville to Mountain Lake, and all the accoutrements, hotels and pavilions at the lake. The road will be run independently of the Fonda, Johnstown & Gloversville systems. John Shanahann has been elected president, Lyman K. Brown vice-president, and E. H Stechel secretary. The road will be placed in first-class condition, and many improvements are planned at Mountain Lake.

Lafayette, Ind.—The Fountain Warren Traction Company, which was promoted two years ago for the construction of an electric railroad from Danville, Ill., to this city, is now assured of the success of the project.

Marshalltown, Ia.—A franchise was lately granted to the Marshalltown Electric & Interurban Railway Company,

Nashville, Tenn.—C. M. Henley, of Columbus, is contemplating building an electric railroad from this city to McMinnville.

Newport, R. I.—The Newport & Providence Railroad Company will erect a power house early next spring.

Omaha, Neb.—H. C. Avery, chief enginer of the Council Bluffs, Tabor, Southern Electric Railway Company has started on a survey of the route by which the company proposes to enter Council Bluffs.

Pittsfield, Mass.—The Western Massachusetts Electric Railway Company has announced that connecting lines between Westfield, Mass., and Hudson, N. Y., were to be built, connecting the Hudson River with the Connecticut River Valley, and furnishing a connecting link in the chain of electric roads between Boston and the Hudson River.

Richmond, Ind.—If the plans of the men back of the Columbus, Greensburg & Richmond Traction Company materialize the company will have one of the greatest systems of trolley lines in the world. The plans contemplate not only a line from Columbus through Greensburg to this city, but also several long branch lines.

Richmond, Va.—The Passenger & Power Company will build an electric railway between this city and Ashland.

Sterling, Ill.—The Rock River Traction Company has been granted a right of way along the south side of the Sterling and Morrison road.

South Bend, Ind.—Construction work will be begun this month on the Chicago-Indiana Air Line electric road between here and Michigan City, where the company has eight miles of grading finished.

White Plains, N. Y.—An effort is being made to obtain permission to build a trolley line from here to Port Chester over a route which has long been opposed by residents and property owners.

POWER PLANTS.

Lindsay, Cal.—McLees Brothers and William McIndo intend to install an electric-power pumping plant on their property west of town.

Loomis, Wash.—The Plamer Mountain Gold Mining Tunnel Company is to erect an electric power plant here.

Rock Island, Ill.—There is a plan to harness the Mississippi Rapids here and use the water power. It is proposed to build a dike 500 feet from the north shore, 20 miles up the river, and get a 15-foot fall which will develop 20,000 hp.

Vicksburg, Miss.—It is stated that S. S. Bullis, of this city, contemplates erecting an electric power plant at Waltersville, a suburb of his city.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅝@12¾c; Lake 12¾@12⅞c.; casting, 12½@12⅝c.

The Buffalo (N.Y.) Frontier Terminal Railroad Company has been incorporated with a capital of $3,000,000.

At the annual meeting of the Citizens' Passenger Railway Company of Philadelphia, held Monday last, the old board of directors was re-elected.

The Bullock Electric Company is making elaborate arrangements for its annual salesmen's meeting, which takes place in Cincinnati January 25.

The use of electrical power on the New York elevated railway has reduced the percentage of expenses to earnings from 51 per cent. to 42 per cent.

It is reported that the quarterly dividend due on the North Chicago Street Railway Company on January 15 will be 1¼ per cent. instead of 2 per cent.

The Edison Electric Illuminating Company, it is stated in Boston dispatches, has acquired the Somerville (Mass.) Electric Light Company, the consideration being $577,000.

The United Traction Company of Albany, N. Y., has declared the regular quarterly dividend of 1¼ per cent., payable February 1. Books close January 21 and reopen February 2.

It is reported from Carlisle, Pa., that negotiations are under way for the consolidation of all the trolley roads in the Cumberland Valley under the name of the Valley Traction Company.

The Prismatic Electric Manufacturing Company of New York has been incorporated with a capital stock of $200,000. The directors are M. E. Wooster, C. E. Bieyer and Leopold Wallach, New York.

The Electric Company of America (Philadelphia) has declared the regular semi-annual dividend of 3 per cent. payable January 30 to stock of record January 20. Books close January 20 and reopen February 1.

The General Electric Company has proposed a reduction in wages of molders employed at the Schenectady plant, amounting to about 33⅓ per cent. They have refused to accept the reduction and a strike is talked of.

The city council of Cleveland, O., on Monday night passed the three-cent ordinance drawn at Mayor Johnson's dictation some time ago. By its terms three-cent fares will be required on every line within the limits of Cleveland.

The Hudson River Electric Power Company recently filed a mortgage in the Saratoga County (N. Y.) clerk's office to the Knickerbocker Trust Company of New York, to secure an issue of 5,000 $1,000 gold coupon bonds, bearing 5 per cent. interest.

There is annouced a combination of two wireless telegraph companies, with a combined capital stock of $15,000,000. The De Forest and the International Companies have been consolidated. The name of the new company is the American De Forest Wireless Telegraph Company.

The bondholders' committee of the Michigan Telephone Company, with counsel, are now in conference with Mr. N. W. Harris, in New York, formulating a plan for the operation of the Michigan Telephone property purchased by the bondholders through Mr. Harris in Detroit some weeks ago. The property, valued by experts at about $10,000,000, was sold under the hammer and went to the bondholders at $4,100,000. By financiers it is considered as an excellent bargain.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Jan. 11
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	143
Metropolitan Street Railway	121⅞
Metropolitan Securities	89½
Ninth Avenue	200
Third Avenue	120
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	50
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	269
Philadelphia.	
Consolidated Traction of New Jersey	65⅜
Philadelphia Traction	97⅝
Union Traction, $17.50 paid	45⅞
Boston.	
Boston Elevated, full paid	140
West End Street, com	89½
do. do. do. pref	110
Chicago.	
City Railway	160
North Chicago	87
Union Traction, com	6⅝
do. do. pref	32½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	21
do. do. pref	50
Electric Lead Reduction	⅞
Electric Vehicle, com	10
do. do. pref	14
Westinghouse, com	171
do. pref	192
General Electric	174⅝
Boston.	
Edison Electric Illuminating	233
General Electric	174½
Massachusetts Electric Companies, com	21
do. do. do. pref	75¾
Westinghouse Electric & Mfg., com	83½
do. do. do. pref	92
Chicago.	
Chicago Edison	147
National Carbon, com	21½
do. do. pref	95
Philadelphia.	
Electric Company of America	8½
Electric Storage Battery, com	58
do. do. do. pref	58
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	125½
Western Telephone Company	8
New England Telephone Company	121
New York.	
American Telegraph & Cable Company	86¼
Commercial Cable Company	178
Mexican Telephone Company	1¾
New York & New Jersey Telephone Company	140
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88¼
Miscellaneous.	
Chicago Telephone Company	120
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	26½
Consolidated Car Heating	66
Standard Underground Cable	220

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CONTENTS.

EDITORIAL NOTES.

A Good Bill. It is about time that something was done to eliminate the dangers of the third rail on the elevated roads in Greater New York. An attempt is to be made to do this "something." A bill is about to be introduced in the Legislature at Albany which, if it becomes a law, will oblige transportation companies to improve their systems. We say "if" it becomes a law, for every effort will be made by transportation companies in the State to have it tabled indefinitely. The bill as it is drawn empowers the State Railroad Commissioners to compel railroad companies to carry out the recommendations of the board. As the law now stands the Commissioners can order changes, but the companies may make them or not as they see fit.

It is said to be the intention of the State Railroad Commissioners if the bill becomes a law to require the Manhattan and the Brooklyn Rapid Transit Companies to devise a safer method of using the third-rail system. Such being the case, it is to be hoped the bill will not find its way into one of the numerous pigeon holes that abound in Albany.

* * *

Will Radium Cure Cancer? From time to time in past years, we have referred in these columns to various alleged electrical cures for cancer. Right here it might be in place to state that up to the present no absolute cure for that dreaded disease has been discovered, although in certain cases treatment by X-rays or by Dr. Finsen's process tends to give relief and retard the spread of the disease.

So far the cases treated have been external ones, but according to Dr. William James Morton it may be possible in the near future to treat internal cancers. This may be made possible through the medium of radium.

Before the Technology Club in this city Dr. Morton last week spoke at considerable length on this subject and explained several discoveries made by him. At the beginning Dr. Morton warned his audience that he did not contend that he had discovered the cure for cancer. He urged on them that he merely had reached certain results with the aid of radium, which he felt justified him in taking his colleagues into his confidence in order that further experiments may be made along the lines he has adopted.

Stripped of all its technicalities, the treatment Dr. Morton has given his patients consists of an outward application of radium to the affected parts, after the body has been prepared inwardly by administering fluorescent fluids which, under the action of the radium, produce ultra-violet radiation.

In other words, by the combination effected through the interior and exterior treatments, what amounts substantially to sunlight is created within the body, and the treatment is the same as though the actual light of the sun was concentrated upon the diseased portion of the body.

At the meeting referred to above Dr Morton explained the reasons and method of his treatment as follows:

"It is well known that certain solutions which may be used as medicines are rendered fluorescent by radium radio-activity and by the X-ray. They are quinine, aesculin fluorescin and orcin. The fluorescence of quinine, aesculin and orcin is of a most beautiful blue-violet color, and where the violet end of the spectrum is found there is also found above it the ultra-violet radiation. Both are capable of these chemical effects, which are usually

known as the effects of the actinic rays of the spectrum.

"It occurred to me that I might combine the properties which the X and radium rays have of penetrating human tissue with these facts of fluorescence, and thus establish a system by means of which we could flood a given organ or seat of disease with a fluorescible fluid used medically and at the same time, by turning the X or radium ray upon this region, set up at desired area actinic radiation, thus bringing to bear the ultra-violet ray in a manner which could not be attained by any application of it from the outside.

"This plan is perfectly feasible, I have already practiced it for some time."

There would seem to be little doubt but what the peculiar and wonderful characteristics of radium will ultimately find its greatest sphere of usefulness in medicine and if any genius can adapt this new element to the cure of cancer he will have conferred upon humanity a benefit for all time.

* * *

Electrical Smelting of Iron Ore. Smelting iron ore by means of electricity has been successfully accomplished in several countries in Europe, namely, in France, Italy and Sweden, and also to a limited extent in the United States.

The Ottawa Government is now looking into the feasibility of this process of reducing ore with a view to its introduction in Ontario and Quebec.

In his recent presidential address before the Canadian Institute of Electrical Engineering, Mr. Robert Raye Gray, the president of that body, made the following reference to the electrical reduction of iron ores:

"Another valuable process, which has made considerable progress during the past year, is the reduction of iron ores by means of the electric furnace. At Livet, in France, the process is in practical operation, generators of 1,200 hp. each giving ingle-phase currents at 30,000 amperes eing employed. The output is 12 tons of teel per day. At these works ferro-silicon is also made from quartz, scrap iron and coke, at less cost than that of smelting, and copper pyrites is reduced to copper and iron sulphides rich in copper and ready for the smelting process. Steel of high quality is similarly produced in Sweden at the rate of 1,500 tons per annum. With the Stassne process, the expenditure of energy is said to be 3,000 hp. per ton of iron."

The Ottawa Government is now examining into the electrical process of smelting iron because in certain localities of Ontario and Quebec there exist extensive iron ore deposits which cannot be successfully worked owing to a lack of adjacent or available coal supplies. It is thought that if the energy now wasted in many waterfalls throughout the interior of the country can be used economically in smelting the ore it will open up a splendid field for profitable enterprise. Such should be the case providing the water power it is proposed to utilize is not too far distant from the ore deposits. At the present time, however, the test of profitable operation will be severe owing to the low price of iron and steel.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

At the next meeting of the Chicago Electrical Association the members will vote on a resolution to affiliate with the Western Society of Engineers.

The Technology Club of this city, composed of the alumni of the Massachusetts Institute of Technology, will give a dinner February 5 at the University Club, at which "liquid sunshine" will be served. Dr. Morton, the discoverer of "liquid sunshine," has given the formula for making this liquid, which in a capsule will be placed at each plate with a glass of water. The room will be darkened, each man will drop the capsule into his glass of water, and will make his own "liquid sunshine," with a tube of radium in this liquid, which will be drunk to Alma Mater.

The experts who witnessed the experiments in wireless submarine signaling conducted last Thursday between New York and Boston are so well pleased with the results that the Government will probably equip many more of the lightships with the submarine bells, providing the owners of steamship lines will put the supplementary apparatus on their boats. Universal adoption of the system would greatly diminish the danger of collision or running aground during fogs, as it was demonstrated during the recent tests that the warning sounds from submerged bells could be heard plainly for at least seven and a half miles.

The Marconi Wireless Telegraph Company is not operating commercially upon land or from shore to shore as yet, but has been successful in its recent experimental operations. Daily communication is now held between Cape Cod and Glace Bay stations, a distance of 700 miles, but the Poldhu station in England has not been equipped as yet to permit of transatlantic communication.

A cable dispatch from Paris says that M. Curie's non-acceptance of the Legion of Honor decoration seems to have encouraged more substantial recognition. One of the best equipped laboratories in the Pasteur Institute has now been placed at the disposal of the savant and his wife. Moreover, a bill has been introduced in the Chamber of Deputies by M. Gerault-Richard opening a special credit of 150,000f. ($30,000) to permit M. Curie to continue his researches. There is every prospect that the bill will be passed by a unanimous vote.

There will be a reunion of members of the Society of Mechanical Engineers on Tuesday, January 26, at 8:30 P. M., at the Society House, 12 West 31st street, New York City. The purpose of this reunion will be to listen to an address by Mr. John A. Brashear, of Pittsburg, entitled, "The Evolution of Measurements." The address will be illustrated.

Tests of an invention by Prof. Michael I. Pupin, of Columbia University, for "strengthening sound waves" are being made by the New York and New Jersey Telephone Company. Thus far results are said to be satisfactory. The system discovered by Prof. Pupin provides for coils wound on wire at regular intervals on a circuit. It has been installed on special underground lines, extending to Kingsbridge, in Manhattan, from New York to Elizabeth and to points on Long Island.

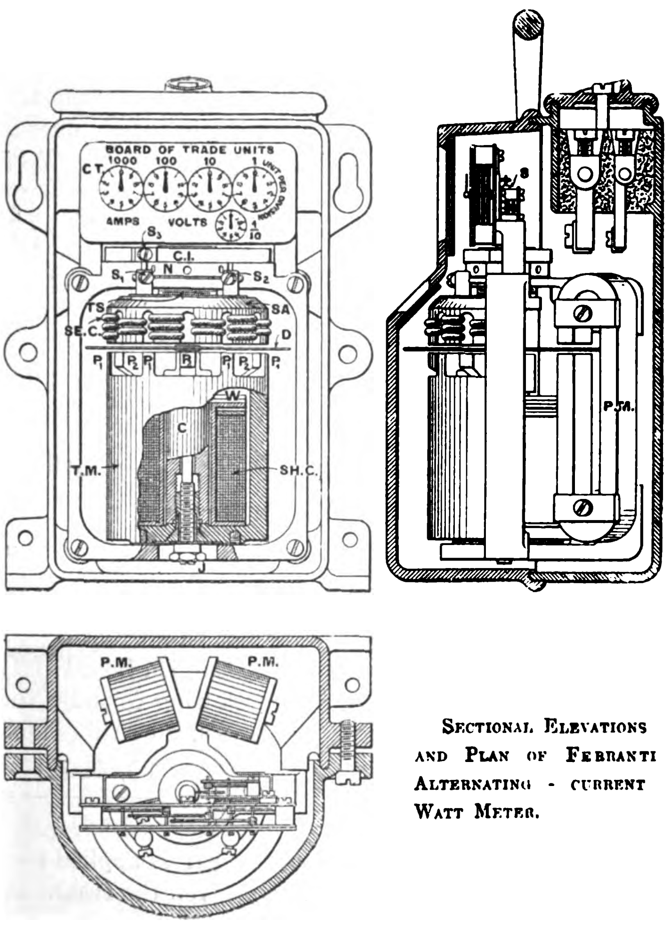
The annual automobile show in New York City began on January 16 at Madison Square Garden and will last one week. More than 185 firms have been accommodated in the distribution of space. The exhibition is held under the auspices of the Automobile Club of America, the National Association of Automobile Manufacturers and the Madison Square Garden Company.

Secretary Wilson informed President Roosevelt last Friday that scientists of the Department of Agriculture had perfected a system of wireless telegraphy. It differs from both the Marconi and De Forest systems. It is now in successful operation between San Francisco and the Farallone Islands, 27 miles. The new system is used by the Weather Bureau and every step in its development is being covered by patents.

FERRANTI ALTERNATING CURRENT INTEGRATING WATTMETER.*

A new alternating current wattmeter possessing certain novel features has recently been brought out in London. The meter is of the induction motor type, measuring accurately the energy consumed on an alternating current circuit, whether the load is inductive or non-inductive; and it is essentially a practical, commercial instrument, the energy being recorded directly in Board of Trade units, and no multiplier or constant is necessary. The accompanying illustrations show clearly the construction of the meter, and indicate the simplicity of its parts.

The aluminum rotatable disk D, mounted on the spindle S and geared to the train of wheels CT actuating the index hands, serves the double purpose of an armature receiving the driving torque of the meter coils and also the retarding torque of the permanent magnets PM. One shunt coil, SHC, placed round the coil C of a special tubular electromagnet, TM, constitutes the shunt system. The core of this magnet has three outward radial poles, P_2, alternating with four inward radial poles, P_1, from the shell or tube of the shunt magnet, the plane of these poles being horizontal and parallel to the disk; this tubular magnet is placed below the disk. It is well known that, in the case of the induction motor type of meter, it is necessary that the shunt circuit should be very inductive, and in this connection a special tubular magnet is found most suitable, no choking coils, secondary circuits, resistances or compensating coils being required. The number of electrical connections is thus reduced to a minimum, and the possibility of trouble therefrom considerably reduced. The series system consists of a slotted armature, SA, above the disk, the series coils SEC being wound in these slots. A wave-form of winding is used, somewhat similar to the winding adopted by Mr. Ferranti for his alternators in 1884; it will be noted that the slots of the series armature are almost directly above the poles of the tubular magnets.



SECTIONAL ELEVATIONS AND PLAN OF FERRANTI ALTERNATING - CURRENT WATT METER.

If the shunt circuit be sufficiently inductive, the eddy currents produced in the disk by the shunt field will be in phase with the impressed EMF. These eddy currents are acted on by the series field, which is in phase with the load current, giving a driving torque on the disk proportional to the EMF. of the circuit multiplied by the amperes and by the cosine of the angle of lag of the main current behind the EMF., this being the true watts supplied to the circuit through the meter. The retarding torque due to the permanent magnets is proportional to the speed, and the disk therefore revolves with a speed which is proportional to the watts. If the series and shunt magnetic systems could be made exactly symmetrical and placed relatively to one another in a symmetrical position—i. e., the slots of the series magnet exactly above the shunt poles—then the disk would not rovolve when the shunt coil alone is energized, and the meter would read low at the small loads owing to the friction of the train and spindle bearings. For the purpose of compensating for any dissymmetry in the magnetic system due to small irregularities in material, workmanship and pivot friction, it is necessary to have some adjustment which gives a driving torque when no current passes through the series coil, this driving torque being insufficient in itself to cause rotation of the disk and train. In many other meters, special grooves, pole extensions or coils are required, but it is an important feature in the Ferranti design that no additional windings or parts are necessary, as the series magnet is simply turned about the axis of rotation of the disk to the necessary extent to effect the required compensation; for if the series magnet is displaced clockwise, the disk will tend to revolve anti-clockwise. But if, on the other hand, the series magnet is put to the other side, the disk will tend to revolve clockwise. Hence it will be seen that it is possible to leave the series magnet slightly out of center in the direction which gives a slight torque on the shunt alone, and this can be very accurately adjusted to compensate for pivot friction or for any dissymmetry in the magnetic circuit met with in manufacture.

The adjustment can be most accurately made, and the meter can be calibrated or adjusted by the simple action of slightly altering the relative positions of the shunt and series magnets, and this is done by means of the two screws S_1 and S_2. The driving torque with the shunt alone, even with the maximum possible displacement of the series armature, is extremely small, and as it will be noted that the armature is fixed by a powerful clamp, Cl, and the two screws S_1 and S_2, the possibility of the meter developing any tendency to creep on the shunt is very remote. The constant of the meter is also readily adjusted by lowering or raising the series armature by means of the nut N on the threaded spindle TS, the effect of this being to strengthen or weaken the action of the coils, and after adjustment the series magnet is securely fixed by means of the strong clamp Cl and the screw S_3. On all conditions of circuit, inductive or

*From the "Electrician," London.

non-inductive, on overloads up to 50 per cent., and under variations of voltage to 50 per cent. above or below the normal, the meter is very accurate, and it is also practically independent of variations in frequency, wave form or temperature. Every meter is calibrated to the following limits of accuracy: $1\frac{1}{2}$ per cent. from one-tenth to full load, and $2\frac{1}{2}$ per cent. from one-twentieth to one-tenth load. The accuracy is not affected by short-circuit through a fuse of double the capacity of the meter. It is said that a 10-ampere meter starts well with 0.05 ampere, and can be relied upon to register with a 250 volt 8 cp. lamp. The losses in the meter are very small, and the efficiency is consequently high; in a 10 ampere 200 volt 100 periods instrument it is claimed that the losses in the shunt circuit are not above 1.7 watts, and the series loss at full load does not exceed 0.8 watt. Only 0.015 ampere is required in the shunt. All Ferranti alternating meters are tested to withstand a pressure of 1,000 volts alternating, applied between windings and case. For convenience in testing, all meters are calibrated to run at a standard speed of 40 revolutions per minute at full load, the standard voltages for calibration being 100, 110, 120, 200, 220 and 240. For intermediate voltages the nearest standard is adopted, this making no difference in the accuracy of the meter.

The terminal box is specially designed to facilitate testing, the shunt being connected to a fourth terminal, which can readily be disconnected from the main terminal, allowing the shunts of several meters to be placed in parallel on the voltmeter leads, and avoiding unnecessary opening of the cases. All meters are fitted with a one-tenth unit train on front dial for facility in testing. The meters are fitted with removable jeweled brass settings, J, which enables a defective jewel to be easily replaced by a new one at any time without altering the calibration of the meter, all parts being interchangeable.

COLLAPSING PRESSURE OF TUBES AND FLUES.

ARTICLE II.

BY W. H. WAKEMAN.

Applying the last figures in Article I to a 3 inch tube 4 feet long shows that the collapsing pressure is 655.6 pounds, or practically twice as much as for the same tube 16 feet long. In this case the collapsing pressure does not vary directly with the length but nearly with the square root of it. The first glance at this formula is sufficient to discourage some readers, but investigation shows that while it is long it is not difficult to apply, as the process is very simple.

D. K. Clark gives the following formula, but does not recommend it for flues more than 6 inches in diameter:

$$\left(\frac{112,000}{D} - 12,000\right) \times t = P.$$

D = diameter in inches.
t = thickness in decimals of an inch.
P collapsing pressure in pounds.

This gives the collapsing pressure for tubes and flues as follows:

3 inch	tube,	2,761	pounds.
4 "	"	2,144	"
6 "	flue,	1,099	"

It cannot be applied to a 12 inch flue because the quotient found by dividing 112,000 by 12 is less than 12,000, therefore the operation fails.

A flue 9 inches in diameter is the largest to which it can be applied, and if we assume the thickness to be .2 inch the collapsing pressure is 67 pounds. A formula which can be applied to a 9 inch, but cannot to a 10 inch flue, is of doubtful value to say the least.

The same authority presents the following for our consideration and adoption:

$$\left(\frac{50,000}{D} - 500\right) \times t^2 = P.$$

D = diameter of flue in inches.
t = thickness in decimals of an inch.
P = collapsing pressure in pounds.

Applying this to the tubes and flues above mentioned gives the value of P for comparison:

3 inch	tube	.109	inch	thick,	192	pounds.
4 "	"	.134	"	"	215	"
5 "	flue	.165	"	"	213	"
12 "	"	.229	"	"	192	"
20 "	"	.32	"	"	204	"
40 "	"	.5	"	"	187	"

It will be noted that the two preceding formulas do not bring the length of tubes and flues into consideration at all, and this is going to the other extreme. His idea is that the length has no more effect on the collapsing than it does on the bursting pressure, which is contrary to the conclusions arrived at by other engineers. While commenting on this idea he says very plainly that the length of tube is the least influential factor, and of very small value, except for very short lengths, as practically all the resistance to collapse offered by plain tubes is supplied by the compressive strength of the material and stiffness of the tube. This is undoubtedly true, so long as the tube is kept perfectly round, but this is an important proviso, which cannot always be realized in practice.

From a large number of collapsed tubes he selects 21, which present a good assortment of lengths and diameters, and by plotting these results and drawing a curve through them, representing the average of the whole, the following formula is derived:

$$\frac{200,000 \times t^2}{d^{1.75}} = P.$$

t = thickness of flue in decimals of an inch.
d = diameter of flue in inches.
P = collapsing pressure in pounds.

The length is not taken into consideration, except in a statement which informs us that it varies from 18 to 40 feet.

At first it appears as if a formula based on the actual results of practical work would be more valuable than any other, but further consideration does not confirm first impressions.

Were all of these flues made of material of uniform quality? Were they all new, or had they seen varying terms of service which would leave them in different conditions? Was the thickness uniform, or was it reduced in places by legitimate wear and corrosion? If one was new and in good condition, and another old and weak, is it proper to take the average of them and adopt it for general use?

Until these questions are answered we have a right to place our own valuation on the formula. The variation in length from 18 to 40 feet shows that there is a chance for this factor to effect the result, and to strike an average in this respect may not be correct.

The English Board of Trade has adopted the following formula for the safe working pressure of tubes and flues:

$$\frac{90,000 \times t^2}{(L+1) \times d} = P.$$

When it is applied to the examples already given the results are as follows:

3 inch	tube	.109	inch	thick,	21	pounds.
4 "	"	.134	"	"	24	"
6 "	flue	.165	"	"	24	"
12 "	"	.229	"	"	23	"
20 "	"	.32	"	"	27	"
40 "	"	.5	"	"	33	"

Applying this to a 3 inch tube 4 feet long gives a safe working pressure of 71 pounds, and for a 40 inch flue 5 feet long it is 94 pounds.

The effect of (L + 1) in this formula is to give a tube 16 feet long less than four times as much pressure as would be allowed on one 4 feet long, but it does not vary the pressure directly with the length, nor yet with the square root of the length,

therefore these two extremes are avoided.

The apparent constant 90,000 may be varied to suit conditions, where the tube or flue is not perfectly round or the workmanship is defective. It may be taken as low as 60,000.

There is a proviso to the effect that pressure on tubes or flues coming under this formula shall in no case exceed the result obtained by the next formula:

$$\frac{8,000 \times t}{d} = P.$$

t = thickness in decimals of an inch.
d = diameter in inches.
P = safe working pressure.

The limit of pressure allowed is much above the results secured by the preceding formula, as the following table demonstrates:

3 inch	tube,	291 pounds.
4 "	"	268 "
6 "	flue	220 "
12 "	"	153 "
20 "	"	128 "
40 "	"	100 "

These pressures are not excessive when viewed from a practical standpoint.

Before passing on to other formulas a general review of those already given are in order. Taken as a whole they are unsatisfactory, because some of them were not intended for use in relation to 3 and 4 inch tubes, but it is not so stated in connection with them, therefore they are taken and applied as found.

Others are apparently designed for comparatively short and large flues, but it is not always so stated.

It is practically impossible to devise a formula that will be satisfactory for small, long tubes and short, large flues.

ELECTRICAL SPEED INDICATORS —SOME UNSUCCESSFUL ATTEMPTS.*

BY A. S. CUBITT.

A short time ago attention was called to the advantages of making public any unsuccessful experimental work, both with the idea of calling attention to the difficulties which beset the path of the experimenter, and also to save later workers the necessity of finding out by unhappy experience the infeasibility of working on certain apparently hopeful lines. With this idea in view, a description of certain experimental and proposed forms of speed indicator which have been devised by the author, and which have been up to the present more or less unsuccessful for reasons which will be stated, may be of interest. Some of the earlier attempts were crude in the extreme, and never proceeded very far even in the experimental stage, but it will be noted that all through one special principle has been adhered to in the main. One of the earliest attempts consisted in interposing a make and break in a circuit comprising an ammeter, a battery, and a resistance, but, as might be expected, it was found that beyond a very small range the value of the current remained stationary for all speeds owing to the fact that the duration of the contact varied inversely as the number of contacts per second, so that the average duration of contact per second remained the same.

It was very apparent that to operate a speed indicator on this principle it would be necessary that the apparatus must be so arranged that the amount of energy imparted to the moving part of the indicator per contact, or its equivalent, must remain a constant. With this idea in mind a mechanical model embodying this principle was devised and built, and proved the correctness of this theory. Mechanical considerations, however, rendered this impracticable, as may be seen. Referring to Fig. 1, a flywheel was con-

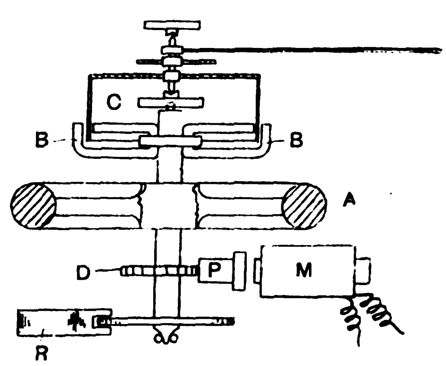


FIG. 1.

structed and pivoted on ball bearings so as to revolve very easily. To this flywheel was attached a set of magnets, B B, designed when revolving to impart a torque to a copper cylinder, C, embraced by them, this torque being proportional to the speed at which the magnets revolved. To the lower part of the flywheel was attached a racket wheel, D, and a copper brake disk revolving between the poles of the magnet, R. The ratchet wheel was arranged to be operated as a pawl, which was normally held clear, but which could be pulled into place by a magnet, M, and which when let go would by means of the spring attached to it impart an impulse to the flywheel. Now, assuming that the amount of energy imparted to the flywheel per kick remains constant, the greater the number of kicks per second the greater the energy imparted to the flywheel and the greater the speed. If a copper brake disk were attached to the flywheel, the speed attained would be proportional to the energy imparted—i. e., to the number of kicks per second. With a simple contact on the transmitter a speed of flywheel proportioned to the speed of the transmitter contact could be obtained, and a means of indicating the speed by indicating the torque in the copper cylinder secured. It was found, however, that owing to the fact—which had been overlooked—that the energy imparted per kick was dependent on the speed of the flywheel at any moment, falling off as the speed went up, the speed curve turned over very quickly, and cut down the range of the instrument greatly. By substituting for the copper brake disk a hysteresis brake having a practically constant back torque independent of speed, the curve was straightened out and a fairly satisfactory instrument attained. Owing to the very high speeds necessary to operate steadily, the life of the instrument was barely 24 hours, and on purely mechanical considerations was abandoned.

At this time the principle of imparting energy to the moving part of the indicator at a rate proportional to the speed to be indicated was shelved for a time, as the difficulties due to the variation of the pressure on tramways—for which purpose the instrument was destined—were considered too great, and experiments were made on a very different type of instrument. A pair of magnets were mounted on a frame which was geared to the axle of the car whose speed it was required to indicate, and this frame and magnets caused to revolve at a speed proportional to the speed of the car. These magnets, which were very powerful, embraced a copper disk controlled by a stiff spring. This disk, under the action of the rotating magnets, took up different positions according to the speed, and by means of a small arm, made contact on one or other of a series of small contacts connected respectively to a set of electromagnets arranged radially in a cast-iron case forming the indicator. A soft-iron needle pointed to the electromaget excited and carried a pointer indicating the speed corresponding. The disadvantages of this instrument were, amongst others, the unreliability of the contacts, the number of wires required, the possible errors of indicating due to the few points available, the method of operating requiring a large torque in order to allow the friction of the moving contact to cut a small enough figure.

After some minor experiments the orig-

*From the "Electrical Engineer," London.

inal principle above referred to was returned to, this time with greater success. After many disappointing experiments it was concluded that a reliable contact, giving a duration of contact independent of the number of contacts per second, was impracticable, it being assumed that this style of contact, or its equivalent, was necessary to give the desired result. In order to obtain this result an entirely novel idea was evolved, which had the merit of being extremely simple. Referring to Fig. 2, it will be seen that an

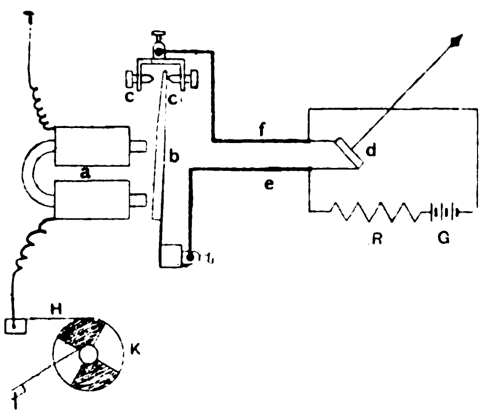


FIG. 2.

auxiliary circuit, comprising a battery, a resistance, and an indicating ammeter, was required. The terminals, f, e, of the moving coil of the instrument, d—in the experiments a Weston milliammeter—were connected by thick wires to the armature, b, and the contact screws, $c c_1$, so that normally the moving coil was short-circuited and the current flowing through the circuit was directed through the armature, b. The battery, G, provided a source of current which was kept to a low value by means of the resistance, R. On the axle whose speed it was required to indicate was placed a contact, K, on which rested a brush, H, and the circuit was so arranged that on revolving the contact, K, the armature, b, would be oscillated between the stops, $c c_1$, at a rate proportional to the speed of the contact, K. The time, however, taken to move the armature from c_1 to c or back would be a constant (the electromagnet being designed to be saturated at voltage below the normal) so that the time the circuit, e, b, c, f, was open each oscillation would be a constant. During this period the current would be free to flow through d, and this would receive a definite impulse. This moving coil was weighted so as to have a considerable mass, and the result was that it took up a definite position corresponding at any time to the number of impulses per second, and, therefore, to the speed required to be measured. This instrument proved quite satisfactory in laboratory operation, but the difficulties in keeping the current constant and the wear of the contacts, $c c_1$, made it unsuitable for practical use. Subsequent experiments evolved a method of doing away with the battery, and by making the contacts of hard steel the wear was sensibly diminished, but as the experiments leading up to these improvements were made on a more suitable type of instrument—which will be described later—no further description will be necessary here.

Whilst experimenting with this instrument with a view to stop the sparking at the contact, K H, which was made in the 500-volt circuit, a high-resistance shunt was connected across K H. This, whilst it considerably lessened the sparking, had the effect of preventing the armature being released when the speed exceeded a certain amount, and the observation of the naturally expected fact, that a considerably less current was required to hold the armature in place than to pull it over, led to the evolution of a novel type of instrument, embodying features which are not to be met with in any other type of apparatus. For want of a better name the principle of this instrument may be described as an "electromagnet ratchet." A reference to Fig. 3 will make this prin-

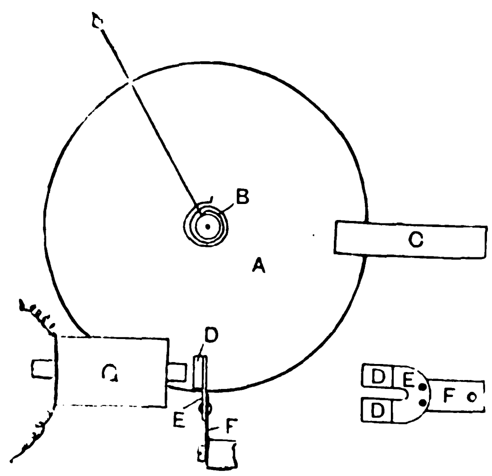


FIG. 3.

ciple clear. A copper disk, A, was pivoted in the center and constrained to remain in the zero position as shown by the spring, B; the movements of this disk were damped by means of the magnet, C. Embracing the disk was the armature, D D, made in two halves, connected by a non-magnetic bridge piece, E. This armature was kept in a definite position with regard to the disk by means of the spring, F. An electromagnet, G, was so placed that the armature, D D, formed part of this magnetic circuit, leaving a gap of about $\frac{3}{16}$ inch between its pole-pieces and the armature D D. This instrument was actuated by means of a simple make and break on the axle.

The operation was as follows: The electromagnet, G, was connected in series with a resistance and with the contact on the axle, and was supplied with current from the trolley wire. In order that the magnetic flux should be practically constant during any changes in the voltage of the circuit, the electromagnet was so designed that its core would be saturated at the lowest anticipated voltage. When the circuit was made, the armature, D D, was attracted and moved over to the pole-pieces. This movement did not take place, however, until the magnetic flux had risen to a fairly high value, and it will be noted that the whole of this flux had to pass through the portion of the copper disk which laid between the two halves of the armature, D D. Thus, when this armature moved over, it exerted a torque on the copper disk by virtue of the eddy currents generated, and moved the disk slightly forward. When the circuit through G was broken, the armature, D D, returned to its initial position by means of the spring, F. This, however, did not happen until the flux had died down to a minimum value, owing to the reduction of the air-gap, so that the torque exerted on the copper disk during the backward motion was very small compared with that exerted during the forward motion. The distance, therefore, that the disk moved back was less than the distance the armature moved back in proportion to the time interval between the successive movements of the armature—that is to say, in proportion to the speed at which the contact on the axle was being made and broken. The result was that the disk was projected forward by the impulses piling one on the other until such a time as the tension on the spring, B, was great enough to constrain the disk to move backwards at the same speed that it moved forward during one impulse—that is to say, until the pseudo torque imparted by the vibrating armature to the copper disk, A, was equal to the torque upon the spring, B. From this it is clear that for every speed of oscillation of the armature, D D, a corresponding definite angular position of the copper disk, A, with regard to its initial position would be found, and by means of a suitable pointer attached the instrument could be calibrated to read direct in miles per hour.

A full-sized working model of this instrument was built, and it was found that the operation followed exactly the lines anticipated, but, owing to the very small movement of the armature, the resultant torque was not great enough to be of any commercial value. In order to increase this torque it was found necessary to use as many as four armatures operating on the same disk, which made the instrument too bulky and complicated to be put for-

ward as a practical instrument. Attempts were made to increase the torque by using an iron disk, and although this was slightly more satisfactory, yet its behavior did not warrant its commercial production. Incidentally it was found that if the armature was allowed to come into mechanical contact with the disk, an apparently satisfactory instrument was obtained with an exceedingly large torque, and an instrument which, moreover, seemed to be perfectly reliable during the short time the trials lasted. But it was anticipated that it would not be possible to make an instrument on these lines which would stand the vibration which such an instrument would have to undergo, and which could be relied on as to its indications as soon as any appreciable wear has taken place.

Some time after this instrument was built a patent was taken out by two gentlemen well known to the author, involving this very principle, and which ap-

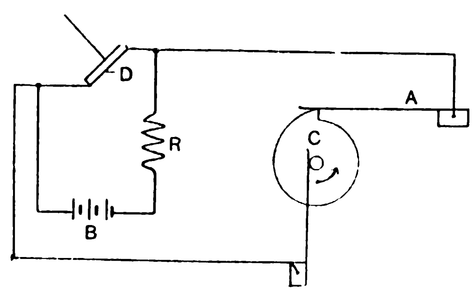


FIG. 4.

peared experimentally to be very satisfactory. This has since been dropped, however, on the same grounds of unreliable operation after any wear had taken place.

During these experiments a very interesting phenomenon was noticed with regard to the curious behavior of some sheet aluminum in a rapidly changing magnetic field. The bridge piece referred to, as connecting the two parts of the armature, was made of aluminum, and it was found that as soon as the armature was started, oscillating curious fern-like shapes semed to grow out from the metal, in a similar manner to that which has been observed when aluminum comes in contact with metallic mercury. A reason for this was never found out, and it would be interesting perhaps to some one with time to spare to investigate this.

Earlier in this article we referred to a method of doing away with the battery used with the type of instruments in which the moving coil of the indicating ammeter was short-circuited during part of the time the instrument was in use. The instrument about to be described was the one referred to, and it will be seen that the means used to render the indicators independent of any change of voltage will be equally applicable to either types. Referring to Fig. 4, D is the moving coil of a Weston type ammeter of very low capacity, B is a couple of cells of storage battery, R is the resistance. The coil, D, is normally short-circuited through the spring contact, A, resting on the cam, C, so that there is practically no current flowing through the coil, D. If the cam, C, is revolved in the direction indicated by the arrow, the spring, A, will rise to the highest part of the cam, as is shown, and then drop down again to the lowest. The time taken to make this drop will be the same whatever the number of times this happens in any given time, and with each drop of this spring the short-circuit of the moving coil, D, will be opened, and therefore current will be free to flow through this coil. We have, therefore, a definite impulse imparted to it in each revolution of the cam, C, and if the moving coil is considerably weighted as before, in order to give it a definite mass, it will be found that for each speed of the revolution of the cam, C, a definite resultant torque will be imparted to the coil D, due to the piling up of the impulses, somewhat in the same manner as in the foregoing instrument. This was the first idea of this method of operation, and in the experiments made it was found that this form of contact was absolutely reliable, provided it was made of sufficiently hardened steel, and provided also that the spring, A, was sufficiently hard and under constant tension, and that all parts in contact at any time were properly cleaned and polished.

In order to overcome the necessity of using the storage battery, or any other external source of energy other than the trolley current, an instrument was devised as shown in Fig. 5. In this instrument, in place of the Weston type ammeter, an instrument of the ratio galvanometer type was used, containing two pairs of coils, C_1 C_2, C_3 C_4, and a soft-iron armature of small section. These coils were connected up, as shown in the figure, between the trolley wire, T, and ground together with the resistance, R. One terminal of C_3 was connected to the spring, A, as shown, the cam being grounded. It will be seen from an inspection of this diagram that as long as the cam is still the pair of coils, C_3 C_4, are short-circuited, so that the magnetic field will lie straight across from C_1 to C_2, and the soft-iron armature will lie across this path, and a pointer attached to this will indicate the zero position. Now, as the cam, G, is rotated for a short period during each revolution, current will be allowed to flow through the coil, C_3 C_4, and will rise in proportion to the number of revolutions of the cam during any given period of time, and, following a well-known law, the resultant field due to C_3 C_4, and C_1 C_2, will take up an angular position whose tangent is equal to the

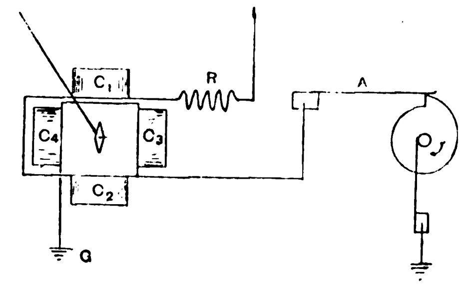


FIG. 5.

ratio of the strength of the two fields due to C_3 C_4 and C_1 C_2. Now, as the strength of the field C_1 C_2 (assuming constant voltage) has a steady value, this ratio will be in proportion to the strength of the field C_3 C_4—that is, to the speed of revolution of the cam. If the impressed voltage changes in any way, it changes equally in both sets of coils—that is to say, the ratio of the two currents, and, therefore, of the two magnetic fields, remains the same, so that the indicating instruments are absolutely independent of the impressed voltage, provided that it does not fall to such a low value that the soft-iron armature is not saturated. As this, however, happens at a very low value, the section of iron being very small, for all practical ranges this instrument will be independent of changes of voltage. It will be noted, however, that the cam, C (Fig. 4) is only capable of rotation in one direction.

Fig. 6 shows a form of cam which was devised, which is capable of rotating in either direction. In this case the single cam is replaced by a double cam, C, having similar upper and lower faces, and a diagonal channel connecting them. When the cam revolves in the direction

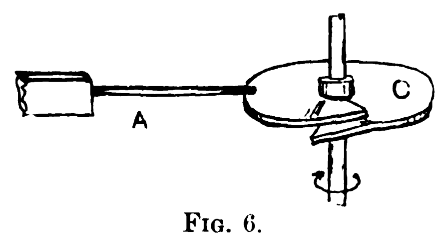


FIG. 6.

shown by the arrow, the spring, A, rises to the highest point on the upper surface and then falls to the lowest point on the upper surface, the operation being similar to that which takes place with the cam shown on Figs. 4 and 5. If, however, the direction of rotation is reversed, the spring, A, passes through the diagonal slot to the lower surface of the cam,

which is similar to the upper surface, but which operates in the opposite direction. Thus the operation of this cam is similar for either direction of rotation, provided the free position of the spring, A, lies in the mid position of the diagonal slot in the cam. It may be mentioned that this type of instrument should not really have been included in the scope of this article, as it promises to be fairly successful in operation. The fact, however, that the instruments which have been described, and which fall strictly within the heading of this article, suggested its conception, led to its being included. This only amongst the instruments which have been mentioned is covered by patents, although several of the other instruments have been patented at one time or another, and have since been abandoned.

In response to a request from some instrument makers to attempt to devise a speed indicator suitable for use with motor cycles, motor cars, etc., an instrument was devised after the following lines: The principle of the instrument depends on the measurement of the torque required to drive a fan at varying speeds. In the model first built the method of operation consisted in allowing the frame of a small clock gear which was driven by means of a pulley at the speed it was required to indicate, to be moved against the tension of a spring by means of the back torque of a fan connected to one of the gear wheels.

In another form of instrument the motion was communicated to the fan through a simple dynamometer, this being a form of the well-known differential gear. The center wheel of this gear was constrained to remain in a definite zero position by a spring, the angular change from this position being an indication of the power transmitted—that is to say, of the speed of the fan. An instrument of this sort is so dead beat that, provided a sufficiently elastic shaft is interposed, it can be driven by means of a ratchet motion actuated by an electromagnet, and yet give a fairly steady indication. Owing to want of time and opportunity, nothing further has been done with this instrument, and should our readers consider it worth while, they are at perfect liberty to follow it up.

The foregoing examples are a few of the most important of the experiments which have have been made by the author during the last five years, and we hope they will have proved of interest.

Dr. Haanel, superintendent of mines, heads the Canadian commission to investigate the electric smelting of ores in Europe.

ELECTRICAL STATION PRACTICE.

ARTICLE XX.

BY W. H. RADCLIFFE.

It has already been shown how a switchboard may be used to regulate, control and protect the electrical energy generated in the station, by means of rheostats, switches, circuit breakers, lightning arresters, etc. Mention has also been made of certain instruments mounted on the board for measuring the voltage and current, and as there are a number of details regarding the operation and maintenance of these, together with the operation and maintenance of meters in general that should be understood by the station attendant, this subject will now be taken up.

The meters previously represented in the switchboard diagrams given were voltmeters and ammeters of the direct and of the alternating current types. A direct current voltmeter consists essentially of a very high resistance connected in series with a coil of fine wire, the latter of which is free to turn between the poles of a permanent horseshoe magnet. Some voltmeters contain a switch or key for closing and opening the circuit through the meter, while others intended to be connected permanently in circuit are not thus equipped. Securely fastened to the top of the coil of fine wire is a pointer which projects above a graduated scale. The passage of a current through the fine wire coil produces lines of force which oppose those developed by the permanent magnet, and which therefore tend to cause a rotation of the fine wire coil about a vertical axis proportional to the strength of the current. The rotation of the coil is opposed at all times by the action of two flat spiral springs, one of which is fastened to the top and the other to the bottom of the coil. When no current is passing through the instrument the action of the spring pulls the pointer back to the zero position, which, in all commercial meters, is practically at the left-hand extremity of the scale. Inclosed within the fine wire coil is a cylindrical core of soft iron; this core does not revolve with the coil but serves to strengthen the magnetic field developed by current in the coil over what it would be were the space occupied by air instead of iron. Since the resistance of the meter is practically constant at all times, the current passing through it is directly proportional to the voltage applied across its terminals. Conversely, this voltage is proportional to the current. There is an old axiom that things proportional to the same thing are proportional to each other; therefore, since the voltage is proportional to the current, and the amount of rotation of the coil or the deflection of the pointer on the coil over the graduated scale is also proportional to the current, the deflection of the pointer is consequently proportional to the voltage. If, therefore, the scale over which the pointer rotates be properly graduated in volts, the position of the pointer over this scale will signify the number of volts to which the matter is subjected.

The graduations of the scale are made at the factory, by comparing the deflections of the pointer with voltages as measured on standard apparatus. The voltmeters in most common use have capacities of 5, 15, 75, 150, 300, 500 and 750 volts each, although in the measurement of very low resistances such as those of armatures, heavy cables, or bus bars, voltmeters having capacities as low as .02 volt are employed. The difference between the design of direct current voltmeters of different capacities lies simply in the high resistance joined in series with the fine wire coil. This resistance is usually about 100 ohms per volt capacity of the meter, and is composed of fine silk-covered copper wire wound non-inductively on a wooden spool. By a non-inductive winding is meant that the wire is doubled on itself before being wound on the spool, so that the magnetic field produced by one-half of the coil may be neutralized by the similar but reversed magnetic effect produced by the other half of the coil. In a voltmeter having a capacity of 150 volts, the resistance introduced would, according to the data just given, be 15,000 ohms, whereas in a voltmeter having a capacity of 300 volts, twice this resistance or 30,000 ohms would be used.

As the capacity of a voltmeter depends upon the value of the resistance in series with it, advantage is often taken of this fact in using with it an instrument known as a multiplier. The multiplier consists of a resistance suitably mounted, whose value in ohms is some multiple of the resistance of the voltmeter with which it is intended to be used. By this arrangement the resistance of the voltmeter circuit is increased a certain whole number of times, thereby decreasing in exact proportion the deflection of the pointer on the scale for a given number of volts. To compensate for the latter change, the deflections of the pointer must be multiplied by the amount of the resistance of the voltmeter circuit has been increased in order to obtain the exact voltage measured. To impress this statement more forcibly, the following example is given: Suppose a multiplier

having a resistance of 50,000 ohms be used in connection with a voltmeter having a capacity of 500 volts, and that a deflection of 400 be obtained on the scale. It is desired to know the voltage which will produce this deflection under the conditions mentioned. From the data previously given a voltmeter having a capacity of 500 volts will have a resistance of 50,000 ohms. This resistance added to the 50,000 ohms in the multiplier will give 100,000 ohms, and this is $100,000 \div 50,000 = 2$ times that normally contained in the meter, so that a deflection of 400 on the scale represents $2 \times 400 = 800$ volts. Although a given voltmeter together with a multiplier containing sufficient resistance might be used in this manner to measure any voltage employed, multipliers enabling pressures up to 40 times that of the scale readings have thus far been the only ones on the market.

The preceding principles laid down in this article apply to all voltmeters for direct current circuits. The details in the construction of these instruments, however, differ according to the service they are intended to perform. When designed for taking measurements in different places they are called portable voltmeters, and when designed for continual use in one place as on a switchboard, they are called station voltmeters. Portable voltmeters and station voltmeters will be taken up in the order named; the former are mounted on wooden bases with the working parts inclosed within metal dust-proof cases. Above the graduated scale on each instrument, an insertion of glass enables the deflections of the pointer to be observed, and to aid in obtaining the correct reading of the pointer there is placed on each portable voltmeter beneath the pointer and extending along the scale a mirror. The use of the mirror for the purpose mentioned consists in placing the eye in such a position that, when looking into the mirror, the reflection of the pointer will be entirely covered by the pointer itself; such being the case, the observer is in the proper position to secure the most accurate reading on the scale, since then he will be directly above the pointer. If the pointer when deflected does not readily come to a position of rest owing to friction in the moving parts, it may be aided in this respect by gently tapping the case of the instrument with the hand; this will often enable the obstruction, if not of a serious nature, to be overcome and an accurate reading obtained.

On many direct current voltmeters of the portable type there are two scales, the one for low voltage readings and the other for high voltage readings; on these scales the values of the graduations for low voltages are marked with red figures, while those for high voltages are marked with black figures. A voltmeter carrying two scales must also contain two resistances in place of one; a terminal from each of these coils must be connected with a separate binding post, but the remaining terminal of each resistance is joined to a wire which connects through the fine wire coil with the third binding post of the meter. The two first mentioned binding posts are usually mounted at the left-hand side of the metal case, and the last mentioned binding post and key at the right-hand side of the metal case. The resistance corresponding to the high reading scale is composed of copper wire having the same diameter as that constituting the resistance for the low reading scale, but as the capacity of the former scale is generally a whole number of times greater than that of the latter scale the resistances for the two must bear the same proportion. This means, since wire of the same size is used for both cases, that the lengths of resistance wire employed must be proportional. Thus, a voltmeter carrying one scale graduated to 5 volts and the other scale graduated to 500 volts, would require two resistances, one of which would be 100 times the length of the other.

In the connection of a two-scale voltmeter in circuit, the single binding post which, as previously stated, is usually on the right-hand side of the instrument, is always employed regardless of which scale is desired. If, then, the voltage be such that it may be measured on the low reading scale, the other binding post employed is that connected to the lower of the two resistances contained within; if, however, the pressure is higher than those recorded on the low reading scale, the binding post to use in addition to the one on the right-hand side of the instrument, is the binding post connected to the higher of the two resistances contained within. Inasmuch as the capacities of the scales are usually marked on or near the corresponding binding posts, there will generally be no difficulty in selecting which of the two left-hand binding posts to employ. In case these binding posts are not marked and only an approximate idea is possessed of the voltage to be measured, it is always advisable to connect to the high reading scale of the meter in order to determine if the measurement may not be made safely and more accurately on the low reading scale. In any case, some knowledge must be had of the voltage at hand, else the high reading portion of the instrument may be endangered. Too much care cannot be taken to observe these precautions whenever the voltmeter is used, for the burning out or charing of the insulation either in the fine wire coil or in the high resistance of the meter by an excessive current, is one of the most serious accidents that can befall the instrument.

If a voltmeter has been subjected to a voltage higher than that for which it was designed, yet not sufficiently high to injure the insulation, but high enough to cause the pointer to pass rapidly over the entire scale, damage has been done in another way. The pointer being forced against the side of the case in this manner, bends it more or less and so introduces an error in the readings that are afterward taken. The same damage will be done when the meter is connected in circuit so that the current does not pass through it in the proper direction, although in this case the pointer is not liable to be bent so much as when it is forced to the opposite side of the meter by an abnormal current, since then it has gained considerable momentum which causes a severer impact. The extent of the damage may be ascertained by noting how far away from the zero mark the pointer lies when no current is passing through the instrument. If this distance is more than two-tenths of a division, the metal case inclosing the working parts should be removed and the pointer straightened by the careful use of a pair of pinchers.

The location of a voltmeter has considerable effect on the results obtained from it. If it is placed near to conductors carrying large currents, the magnetic field developed thereby will produce a change in the magnetism of the instrument, and so introduce an error in the readings.

In wiring portable voltmeters in circuit, the connecting wires or cables must be firmly secured to the support on which the meter rests so as to reduce the possibility of their being pulled by accident, and so causing the meter to fall. A fall or a rough handling of the meter at once shows its effect on the readings, for as much harm is done as would result from a similar treatment of a watch. The hardened steel pivots used in all high grade voltmeters are ground and polished with extreme care so as to secure and maintain a high degree of sensitiveness. The jewels on which the moving parts revolve are of sapphire, and they too must necessarily be made with skill and carefulness; if, therefore, the jewels become cracked and the pivots dulled by

careless handling, the meter at once becomes useless as a measuring instrument.

When taking measurements, the deflections of the pointer should be read to tenths of a division; this can be done with considerable accuracy, especially after a little practice. For very accurate results, a temperature correction should be applied to the readings to compensate for the effect which the atmospheric temperature has upon the resistance of the meter when measurements are being taken. If, however, Weston's portable instruments be used, the temperature correction is negligible, being for resistance corresponding to the high scale less than one-quarter of 1 per cent. for a range of 35 degrees above or 35 degrees below 70 degrees Fahrenheit.

Station voltmeters of the direct-current type operate on the same principle as do portable voltmeters. They are, however, constructed larger, so as to be easily read at a distance, and the containing case is of iron. Iron is used principally because it shields the working parts of the instrument from external magnetic influences by collecting within itself the lines of force associated therewith. To render the deflections of the pointer easily discernible at a distance, the scale is composed of opal glass with black graduations; directly behind the scale an incandescent lamp is mounted, and this together with a pair of mirrors illuminates the background very evenly, permitting at the same time the graduations and figures to stand out most effectively.

In a station providing constant potential service, a great convenience is afforded by employing a voltmeter equipped with a normal index. This is a circular disk, usually of blackened aluminum, which projects over the scale just beneath the graduations; its position along the divisions may be varied by turning a knob mounted on the front of the case. By placing the disk so that it occupies a position directly beneath the point of normal voltage, the pointer when indicating this value will be immediately over it. Owing to a circular opening somewhat larger than the disk, cut out of the pointer at the part which travels on a level with the disk, there will be a narrow ring of white visible between the disk and circular opening when the pointer is in its proper position. A very small variation in the voltage developed can therefore be detected without difficulty at a considerable distance from the meter.

A station voltmeter being generally used to indicate the pressure of the generator wired to the switchboard, must of necessity be connected across the terminals of this machine, or across the leads running therefrom. Care must consequently be taken to guard against any short-circuiting of the voltmeter, which, of course, would mean a short-circuiting of the generator and as a result the probable burning out of its armature. The high resistance of the voltmeter prevents any such occurrence when it is connected in the proper way, but should one side of the circuit be grounded to the metal case or frame of the meter, a careless handling of the lead connected with the other side of the circuit would produce the result just mentioned. Station voltmeters are usually connected permanently in circuit; there is therefore a certain amount of heat developed in the wiring of the instrument which is proportional to the square of the current, the resistance of the voltmeter, and the time during which it is connected in circuit. This heating effect of the current increases the voltmeter resistance and consequently reduces the current below that which otherwise would pass through the meter; since the deflections of the pointer are in reality governed by the strength of the current, station voltmeters invariably indicate a voltage slightly lower than that which actually exists across the leads.

INTERURBAN ELECTRIC TRACTION SYSTEMS--A. C. VS. D. C.*

BY P. M. LINCOLN.

(*Concluded from page 25.*)

4. Attendance at Sub-stations Done Away With.—The direct current rotary being a piece of revolving machinery, of course requires manual attendance at the various sub-stations. Alternating current sub-stations consist of static transformers only, and therefore require attendance only for the purpose of operating the switches. Making the switching devices entirely automatic in their operation avoids the necessity of attendance for this purpose. A still further requirement is the use of distant controlled switches operated from a central point, say the main power house. Electrically operated switches have already been developed to be operated from a distance of several hundred feet, and no reason exists why this distance of operation cannot be extended to twenty or thirty miles by proper design.

5. Electrolysis.—Electrolysis of parallel conducting systems is generally recognized as one of the most serious dangers in connection with present direct current trolley systems, and the fact that an alternating current system avoids this danger entirely need only to be mentioned in order to be recognized as a marked advantage.

So much for the advantages which accrue to the alternating current system. Now, the question arises, what points must be sacrificed in order to obtain these advantages? The disadvantages which necessarily accompany the use of the alternating current traction systems are as follows:

1. Additional weight.
2. Difficulty of operating on existing lines.
3. Increased rail loss.
4. The fact that an active EMF. exists between field turns.
5. Possible interference with telephones.

Now, suppose the above points in detail be taken up:

1. Additional Weight.—An alternating current motor of a given capacity is necessarily somewhat heavier and more expensive than a direct current motor for the same capacity. This difference in the motor, however, does not constitute the total difference in weights of equipment. In order to make use of the advantages of high trolley voltage, the alternating current equipment should preferably be provided with a step-down transformer on the car. Also, in order to obtain the advantages of avoiding the rheostatic losses, some provision must be made for controlling the voltage on the car. The transformer, the voltage control apparatus and the greater weight of motors makes the alternating current equipment necessarily heavier than the direct current. Although this difference need not, and, in many cases, will not be as great (18 per cent.), still a difference in weight will always exist detrimental to the alternating current equipment. This greater weight of the alternating current equipment is one of the items on the debit side of the ledger.

2. Difficulty of Operating on Existing Lines.—Practically all interurban roads run in and through cities on existing tracks, and, therefore, must use the existing sources of direct current power. In order to meet this condition, the equipment for an alternating current interurban road must be so arranged as to operate outside the city and on direct current inside. Although this is entirely possible, it must necessarily prove to be a matter of considerable complication. It means, in the first place, the use of motors which can be operated from both direct and alternating current. This is entirely possible with the series alterna-

*Abstract of paper read before the Electrical Section of the Canadian Society of Civil Engineers, Nov. 19, 1903.

ting current motor. It means, in the second place, that another system of control must be added to the car. This objection might in part be avoided by using rheostatic control for both the alternating current and direct current conditions, but the objection obtains that this method will deprive the alternating current system of its advantage of saving rheostatic losses.

3. Increased Rail Loss.—Experiments have shown that with alternating current from 2,000 to 3,000 alternations, the actual loss which takes place with a given current through the iron rails is from three to five times that which the same direct current would give. The ratios of loss hold for the higher frequencies. At first thought this seems to be an important objection to the a. c. system. But when it is considered that in order to utilize the main benefit of the alternating current, a higher trolley voltage is used, and therefore, smaller currents in the return conductor, the element of rail loss in an alternating current proposition may be made even a smaller proportion of the total than in the direct current in spite of this apparently large handicap. The rail loss with direct current is usually a small proportion of the total and this with alternating current, at the trolley voltages which are usually considered, viz., 2,000 to 5,000, becomes a much smaller proportion.

4. Active EMF. Between Field Turns.—The space that can be assigned to the motor for operating a car is necessarily limited. It is this limitation of space, in fact, which often forces the use of a four-motor equipment instead of a two, the available space not being large enough to allow the installation of motors, two of which are sufficient for the work. When we consider the a. c. motor, the question of space available becomes still more exacting, first, because the a. c. motor is necessarily heavier, and therefore occupies more space than an equivalent d. c. motor; and, second, because the active EMF. that exists between the field turns in the a. c. motor, and which, other things being equal, again requires additional space for insulation. In the matter of EMF. between field turns, the a.c. and d.c. motor are quite different. The EMF. between the field turns of a d. c. motor is due simply to ohmic resistance and a short circuit between turns simply throws out of action the turns so short-circuited, and, if not too severe, does not interfere seriously with the motor's operation. Between field turns of the a. c. motor, on the other hand, there is an active EMF. similar to that between turns of a transformer winding. A short circuit between field turns in an a. c. motor, therefore, means a destructive short circuit and an immediate interruption of service from that motor.

5. Interference with Telephones.—It is a question whether alternating current in the rails will interfere with telephones and similar instruments more than the direct current which they have to contend with at present. In any event, the amount of current in the rails can be reduced by the use of higher voltages so that this source of interference can be made less than it is with the present direct current system. Further, means have been proposed whereby the current can be confined entirely to separate conductors provided for the purpose, and not allowed to wander at will through any return circuit that may exist, as is the case with the direct current system. This can be done, of course, only at the expense of erecting a separate system for the return currents and a system of series transformers whereby these currents can be confined to this return system. The alternating current system, therefore, possesses the advantage of being able to use the rails for contact and still not allow the alternating currents to escape at will through the earth. As a matter of fact, interference with other circuits by the alternating current system is expected to be less than with the present direct current system.

Society of Chemical Industry.

The next meeting of the New York Section will be held at the Chemists' Club, 108 West 55th street, Friday evening, January 22, at 8:15 o'clock. Papers will be read by J. Merritt Matthews, Martin L. Griffin and Edward Durant.

PERSONAL MENTION.

Mr. Irving H. Reynolds, formerly with the Allis-Chalmers Company, and for many years identified with the design and construction of that company's engines, has accepted a position with the William Tod Company of Youngstown, O., as consulting engineer.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JANUARY 12, 1904.

Electric Railways and Appliances.

749,160. Electrically-Operated Railway-Switch. Claude W. Breedlove and Rudolph R. Grant, Berkley, Va. Filed March 25, 1903.

749,301. Trolley-Stand. Washington H. Kilbourn, Greenfield, Mass., assignor to the Stanley Electric Manufacturing Company, Filed Aug. 14, 1902.

749,401. Electric Railway. Leon W. Pullen, Philadelphia, Pa., assignor to the Wireless Railway Company, same place. Filed April 18, 1903.

749,509. Trolley. Willis D. Williams, Kirkland, Ariz. Filed Aug. 19, 1903.

749,597. Electric-Railway Switch. Johann G. Weniger, New York City. Filed June 9, 1903.

749,601. Trolley-Harp Device. Frederick H. Allen, Dunkirk, N. Y. Filed Nov. 2, 1903.

Electric Lights and Appliances

749,268. Electric-Arc Lamp. George R. Davison, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed May 8, 1903.

749,500. Miner's Electric Lamp. Henry G. Prested, Camden Town, Eng. Filed Feb. 7, 1903.

Electrical Machinery and Apparatus.

749,255. Electric Interlocking Switch and Signal System. Gustave Bleynie and Theophile Ducousso, Paris, France. Filed March 6, 1902.

749,271-749,272. Electric-Motor Control and Motor Control. Samuel T. Dodd, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Filed June 4-13, 1903.

749,324. Electric Sparking Ignition Apparatus for Gas Rock Drills, John V. Rice, Jr., Edgewater Park, N. J., assignor to the John V. Rice, Junior Company, same place. Filed June 8, 1895. Renewed July 16, 1898.

749,416. Safety-Appliance System for Electrically-Actuated Elevators. Harry G. Wright, Providence R. I., assignor to William C. Woodward, same place. Filed May 9, 1903.

749,439. Electrical Controlling Apparatus. John D. Ihlder, Yonkers, N.Y., assignor to the Otis Elevator Company, East Orange, N. J. Filed March 22, 1902.

Telephones and Telephone Apparatus.

749,225. Telephone System. Hope Redmon, Rufus L. Hall and Robert H. Conway, Cynthiana, Ky. Filed Nov. 10, 1902.

749,306. Telephone System. Albion D. T. Libby, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Dec. 3, 1902.

749,308. Telephone-Exchange. Frank A. Lundquist and John K. Norstrom, Chicago, Ill., assignors to M. E. Richardson, trustee, Sterling, Kan. Filed Nov. 19, 1900.

749,388. Locking Device for Telephone Apparatus. Sherwood J. Larned and James S. Ford, Chicago, Ill., assignors to the American Telephone & Telegraph Company. Filed Oct. 9, 1903.

749,399. Alternating-Current Relay. Greenleaf W. Pickard, Amesbury, Mass., assignor to the American Telephone & Telegraph Company, Filed Aug. 21 1903.

749,448. Telephone-Transmitter. Philip G. Randall, Boston, Mass. Filed Feb. 9, 1903.

749,481. Telephonic Repeater. Merritt Gally, Brooklyn, N. Y. Filed April 18, 1903.

Miscellaneous.

749,178-749,434. Wireless Signaling Apparatus. Lee De Forest, New York City. Filed March 5, 1903, June 4, 1903.

749,185. Electrode. Rudolf Hager, Halensee, near Berlin, Germany. Filed Jan. 31, 1901.

749,191. Electric Signaling Apparatus. Felix B. Herzog, New York City. Filed May 17, 1886.

749,199. Skeleton Frame for Tanks or Cells of Electric Batteries. Daniel F. Jones, Providence, R. I. Filed Oct. 17, 1903.

749,335. Insulator. Louis Steinberger, Brooklyn, N. Y. Filed Sept. 18, 1902.

749,336. Insulated Support for Wires. Louis Steinberger, New York City. Filed Nov. 12, 1902.

749,365. Electric Bell. Harry E. Dey, New York City. Filed Aug. 15, 1901.

749,371. Wireless Telegraph Receiver. Lee De Forest, New York City. Filed June 4, 1903.

749,372. Art of Wireless Telegraphy. Lee De Forest, New York City. Filed June 4, 1903.

749,387. Automatic Non-Interfering Repeater for Fire Alarm Circuits. William H. Kirnan, Bayonne, N. J., assignor to the Gamewell Fire Alarm Telegraph Company. Filed Oct. 4, 1902.

749,391-749,392. Bond and Elbow for Conduits for Electric Wires. George A. Lutz, New York City, assignor, by mesne assignments, of one-half to Frank K. Boland, same place. Filed May 7, 1901. Renewed June 5, 1903.

749,426. Lightning-Arrester. William E. Cone, Memphis, Mo. Filed May 28, 1903.

749,435. Generating Set for Wireless Telegraph. Lee De Forest, New York City. Filed June 17, 1903.

749,436. Wireless-Telegraph Range-Finder. Lee De Forest, New York City. Filed June 17, 1903.

749,460-749,461, Electric Furnace. Le Roy W. Stevens and Bernard Timmerman, Chicago, Ill., assignors to the Advance Furnace Company of America. Filed Aug. 8, 1902, Oct. 29. 1902. Renewed June 17, 1903.

749,495. Electric Striking Clock. William Olsen, Jersey City, N. J. Filed Dec. 31, 1902.

749,584. Wireless Signaling System. Harry Shoemaker, Philadelphia. Pa., assignor, by direct and mesne assignments, to the International Wireless Telegraph Company and Marie V. Gehring, Philadelphia, Pa. Filed Oct. 3, 1902.

749,628. Electric Heater. George J. Peacock, Pittsburg, Pa., assignor of one-fourth to Charles Bonini, same place. Filed April 19, 1902.

749,633. Electrical Hose Signaling Apparatus. William G. Seeley, Brookline, Mass. Filed May 25, 1903.

THE TELEPHONE WORLD.

Independent Companies Resist Postmaster General's Order.

According to a dispatch from Cleveland, O., the order of Postmaster General Payne, which bars from the Post Office of the United States all Independent telephones, has raised a row. The order prescribes that only the instruments of the companies that have long-distance connections with Washington shall be used. This means that the Bell Company shall have a monopoly of the business.

In the Middle and Western States the Independent companies have a very extensive service and their charge of discrimination is being taken up by Congressmen. Cleveland, as the headquarters of many of the largest of the companies, has started the fight against the order, and it is aided by the National Association of Independent Telephone Companies and the State Telephone Association. A personal appeal has been made to President Roosevelt, who has promised to make an investigation.

Senator Hanna has been appealed to by capitalists interested in the Independent companies, many of whom are his warmest friends. Congressmen, too, have been interested, and the question is certain to be entangled with politics. While New York, Boston, Baltimore and Washington are the only big cities in the East without an Independent company, Cincinnati is the only city between the Alleghenys and the Rockies that has not a large list of Independent line subscribers.

The president of the Cuyahoga Company, Independent, has declined to remove his 'phones, saying that he will make a fight and trust to the courts for his money.

At a meeting of the Southern Iowa & Northern Missouri Telephone Association, held recently in Kirksville, Mo., it was decided to form a company with a capital stock of $100,000, for which bonds will be floated for the purpose of constructing a long-distance line from Moberly through Macon, Kirksville, Lancaster, Southern Iowa, Des Moines, Downing, Memphis, Kahoka and Keokuk. A committee, of which J. M. Kennedy was made chairman, was appointed to organize a company.

The American Car Telephone Company, capitalized at $2,500,000, was lately added to the list of Grand Rapids, Mich., big corporations. Although incorporated under the laws of Arizona, its general office will be in Grand Rapids. The officers are: Theodore Morgan, of Muskegon, president and general manager; F. W. Lyle, Dowagiac, vice-president; E. L. Siver, Grand Rapids, secretary and assistant general manager.

George Finch, of Escanaba, Mich., owner of the Finch Independent telephone system there, will extend his toll lines from Delta County to Menominee and Cedar River, in Menominee County. The work will commence early in the spring. Mr. Finch also intends to apply for a franchise to build a telephone system in Menominee in opposition to the Bell.

W. A. Booth, P. B. Davis and G. M. Cornett have formed a company with a capital of $10,000 to build 60 miles of telephone lines between Prineville, Bend and Sisters, Ore.

Representatives of Independent Companies Confer.

Representatives of 13 Independent telephone companies in Central and Western Illinois met recently in the offices of C. F. Tonn, general manager of the Illinois Telephone Company in Jacksonville, Ill., for the purpose of organizing an Independent Telephone Association and arranging matters so that it will be clearly understood what part of the gross charge each company is to receive for the transmission of a long distance message, or of messages other than local.

It is expected during the present year to establish copper metallic circuits between Hannibal, Springfield, Alton, Louisiana, Jacksonville and other cities of importance in the district embraced by the following counties, which were represented in the meeting: Calhoun, Jersey, Macoupin, Greene, Scott, Morgan, Cass, Sangamon, Pike, Adams, Brown, Hancock, Hannibal and several counties in Missouri.

When copper wires have been stretched between the leading cities in these counties a long distance circuit will have been established, and will be of inestimable value to the various Independent companies. It is also expected that the wire through to Chicago will be completed during the coming summer, when communication may be had direct with that city. Preliminary steps were taken at the meeting toward fixing the amount of toll due each company when a long distance message is transmitted through several of them.

The following gentlemen were present at the meeting: C. F. Tonn, general manager of the Illinois Telephone Company; J. L. Jennings, of Fayette; W. H. Ramsey, of Auburn; John G. Pratt, of Virginia; E. D. Boynton, of Pleasant Plains; W. G. Tucker, of Virden; W. J. Finch, Jr., of Chesterfield; A. T. Vanninan, of Girard; A. F. Loehr, of Carlinville; Ed. D. Glandon, of Pittsfield; H. G. Conger, of Hannibal; F. W. Kelley, of Springfield, and W. B. Rogers of Waverly.

Nine of the leading citizens of Estherville, Ia., have formed an Independent telephone company, and have petitioned the city council for a permit to build, operate and maintain an Independent system in Estherville. The new company expects to extend its lines to the rural districts and to connect with other lines on all sides of Estherville. It is said to have plenty of capital behind it.

The annual meeting of the Rome, N. Y., Home Telephone Company was lately held. Fred M. Shelley was re-elected president; John S. Wardwell, vice-president; and D. Odell secretary, treasurer and manager of the company. The company now has 1,004 'phones in service in that city.

According to Dover, Del., dispatches, the Diamond State Telephone Company has bought control of its last competitor on the peninsula, the Peninsular Telephone Company, which has a system of 125 miles, extending to Virginia.

The Chicago Telephone Company now has 101,200 telephones in service having added 1,600 in December. The gain for 1903 was about 22,100 instruments.

Growth of a Western Company.

Two years ago a few of the citizens of Benedict, Neb., organized the Benedict Telephone Company with $10,000 capital stock, with the idea of putting in some 'phones in the village and two or three lines in the country for the convenience of business interests. In one year they reorganized and became the York County Telephone Company, with authorized stock of a half a million dollars. To-day they have toll connections with over 30 towns and over 1,000 'phones in York County. The board of directors of the company are some of the solid men of the county, and the company has succeeded beyond their most sanguine expectations. Two years ago when the switchboard was purchased for Benedict it was supposed it would not be filled up for years, but to-day it is full and people are clamoring for 'phones that cannot be supplied until a new switchboard is secured.

The San Diego, Cal., common council lately sold to Arthur Wright, of Los Angeles, a telephone franchise for San Diego for $300. It is understood the purchaser represents the Home Telephone Company. He will put in a guarantee bond to expend at least $120,000 in the construction of a plant. The franchise will be formally awarded in 30 days. There was no opposing bid, although representatives of the Sunset Company were present.

A certificate filed with the State Department at Albany, N. Y., sets forth that the Baiting Hollow & Roanoke Telephone Company of the town of Riverhead has increased the amount of its capital stock from $5,000 to $20,000. The company's directors include A. B. Young, Charles H. Warner, H. R. Talmage, John C. Young, F. O. Reeve, E. E. Mosier and W. R. Fanning.

W. E. L. Gaine, general manager of the National Telephone Company of Great Britain, accompanied by Frank Gill, engineer in chief of the company, are making a tour of this country and Canada visiting telephone and electrical plants. They have a great telephone system in their own country, but Mr. Gaine said they never come to the United States but they gain ideas.

At a recent meeting of the Taylorsville & Bethlehem Telephone Company, at Elk Creek, Ky., the following officers were elected: President, William V. Wiggington; secretary and treasurer, William McMakin; general manager, Dr. J. L. Long, and Arthur Van Arsdale, lineman.

The Athens, Tenn., Telephone Company has changed hands and is now owned and managed by Eugene Horton, who is preparing to overhaul the plant and put it in first-class condition.

The Monrovia, Cal., Telephone & Telegraph Company has filed a certificate of bonded indebtedness of $25,000.

G. Y. Stamp, of Melrose, Ky., has bought the telephone exchange at Stithton, Ky., formerly owned by H. W. Bryant.

A telephone system connecting Lorane with
projected.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Attica, O.—This city will vote to issue $6,250 of bonds for electric light purposes.

Clinton, Ia.—The Dewitt Electric Light & Power Company has voted to purchase a new and larger dynamo and perhaps a new engine, as the present two are too small.

Clinton, S. C.—It is stated that an electric plant is to be erected at Musgrove Mill on Enoree River for Thornwell Orphanage. Rev. W. P. Jacobs, president.

Colfax, Wash.—Nicholas Codd, one of the proprietors of the Colfax electric light plant, and James A. Ralph have bought the electric light plant at Dayton. Mr. Ralph will have charge of same.

Creston, Ia.—M. E. Springer, of Des Moines, may install an electric light and gas plant here.

Eau Claire, Wis.—The city council has appointed a committee to investigate the desirability of city ownership of the electric light plant, and requested the Commercial Association to appoint a committee.

Elizabethtown, Pa.—The Elizabethtown Electric Light Company will enlarge its building and add sufficient machinery to more than double the capacity of the present plant.

Fairmont, Neb.—Electric lights are again being discussed here.

Hailey, Idaho.—Harry J. Allen proposes to construct an electric plant to cost about $75,000, to supply power and light to this town, Ketchum and B ll vue.

Hamilton, O.—The Hamilton Heating & Power Company has asked for a franchise for a lighting and heating plant here.

Langdon, N. D.—A new dynamo is to be installed in the electric light plant here.

Lexington, Ky.—A franchise is to be asked here for a new electric lighting plant. W. H. McCorkle is interested.

Matehuala, Mex.—James Kilton has obtained a contract for supplying this city in the State of San Luis Potosi, with electric light and power and to establish a waterworks system. Work has been started. Four electric generating stations will be erected.

Middletown, Ill.—An electric light plant is to be erected. Mr. Allison is interested.

Negaunee, Mich.—The municipal electric light plant is to be improved at a cost of $15,000.

Newton Falls, O.—A proposition to establish an electric lighting plant has been made to the council, but the citizens want waterworks and sewers in addition to street light.

Norwich, N. Y.—The Norwich Gas & Electric Company is negotiating for a contract to light this village.

Oneida, N. Y.—There is a movement under way to start an electric light plant here.

Opelika, Ala.—The Alabama Electric Light & Power Company has been incorporated with a capital of $50,000 by C. S. Abercrombie, H. C. Davidson, of Montgomery, and others.

Pelican Rapids, Minn.—The village council has voted to issue $5,000 more in electric light bonds, making $15,000 in all.

Pitcairn, Pa.—The electric light plant here was lately damaged by fire.

Pittsfield, Ill.—The Pittsfield electric light and power plant was sold to Kendal & Whiting of Geneva Lake, Wis., for the sum of $20,000.

Salt Lake City, Utah.—General Manager Campbell, of the Utah Light & Railway Company states that the company will make a number of improvements to the plant. The power plant is to be increased considerably.

Sandersville, Ga.—Sealed proposals will be received by the water and light commission of this city, of which W. A. McCarty is chairman, until January 27, for constructing a complete system of waterworks and an electric light plant. The electric light plant is to consist of two electric generators, 50 and 75 kw. capacity; two high-speed engines, 75 and 110 hp; switchboards and station instruments; 40 arc lights, 2,000 cp.; complete arc and incandescent circuits, transformers, etc.

South McAlester, I. T.—This city has outgrown its electric light plant and power house.

Taylorsville, O.—At a recent meeting of the town council a proposition was submitted for lighting of the streets and public buildings of the town with electric lights. The proposition was submitted by Messrs. William H. Frazier, of this place, and ex-Senator C. U. Shryock, of Zanesville.

Waddington, N. Y.—This town, at a special election, has voted to sell its municipal electric light plant and water power and rights to a Canadian company for $3,750, the amount which remains unpaid on the plant. The municipal operation of the concern has not proved satisfactory.

Wilkes-Barre, Pa.—The Co-operative Electric Light Company is being organized with Frank Slattery, attorney, as president.

STREET RAILWAYS.

Brazil, Ind.—H. D. Falls and O. E. Adams are the promoters of an interurban electric line between this city and Diamond.

Brooklyn, N. Y.—The Brooklyn Rapid Transit Company expects to abandon the locomotive service entirely on April 1.

Cooperstown, N. Y.—The long and expensive litigation which since last May has prevented the completion of the trolley line to Mohawk has come to an end and Superintendent Jennings is given 18 months to complete the road, and $250,000 to do it with. Work will be resumed in the spring.

Dubuque, Ia.—The Interstate Construction Company, which will build an electric line from here to Platteville., Wis., has been incorporated with a capital stock of $750,000. Peter Kiene of this city is president.

Durand, Mich.—The common council here has been asked to grant J. D. Leland, cashier of the First National Bank, and Charles Irwin, of Philadelphia, a franchise to operate an electric railway in this city.

Elkhart, Wis.—A new franchise was granted the Sheboygan, Elkhart Lake Railway & Electric Company to lay tracks in this village.

Granite, Ill.—The St. Louis, Granite City & Alton Traction Company has been incorporated with a capital stock of $150,000, and W. H. Warnock, F. E. Allen, D. Francis and others as the directors.

Harrisburg, Pa.—The Valley Traction Company and the Harrisburg & Mechanicsburg Electric Company have been merged. The lines cover all the lower part of Cumberland County, Pa., and extend into this city. M. C. Kennedy, of Chambersburg, is president. It is understood that leases of several other lines in Cumberland and York Counties will be secured.

Lancaster, Pa.—A movement is on foot to build a trolley line to connect with the Strasburg line. C. R. Kerr has been chosen president of the new company.

Napoleon, O.—There is a project on foot, which has every prospect of success, to build an electric railway line from Detroit to this place. The company will be known as the Cincinnati, Toledo & Detroit Short Line, and will be capitalized at $500,000.

Nashville, Tenn.—Dr. J. R. Shepard and his associates are the promoters of an electric road from here to Lewisburg.

New York City.—The New York, Westchester & Boston Railway Company has perfected plans for a modern third rail electric road from this city to Port Chester. The route is almost an exact duplicate of that laid out by the New York & Port Chester Railroad. William L. Bull, former president of the Stock Exchange, is president. Dick & Robinson, of No. 30 Broad street, are members of the financing syndicate There will be an issue of $15,000,000 first mortgage 5 per cent. gold bonds.

Rock Falls, Ill.—The Dixon, Rock Falls & Southwestern Electric Railway Company is to locate its power plant and car barns here.

Toronto, Ont.—J. H. Coburn, of Walkerville, will apply to the Ontario Legislature for a charter for an electric railway from Windsor to Walkerville.

Wilkes-Barre, Pa.—The indications are that in a short time there will be third-rail electric systems in connection with several of the railroads in this vicinity. It is now known that the Delaware & Hudson Railroad will equip its road between here and Carbondale with a third-rail system for passengers.

POWER PLANTS.

Bloomington, Ind.—The Indiana State University will erect a power plant, 50 x 100 feet, of brick and stone construction, which will cost $20,000.

Granville, N. Y.—The Granville Electric Light & Gas Company has acquired water rights at the outlet of Lake St. Catherine near here. The purpose of the company in acquiring these water rights is to dam the lake and use the fall to generate electricity for lighting and power. A dam will be built at the outlet, the source of Mettowee Lake, and a storage reservoir established. By means of this dam and one already established where the Mettowee River flows through Granville, it is expected 200 hp. can be developed in dry weather. The officers of the company are: President, F. D. Pember, Granville; vice-president, Brodie G. Higley, Sandy Hill; secretary and treasurer, E. R. Norton, Granville.

Seattle, Wash.—The Everett Improvement Company will harness May Creek near Wallace for electric power. George Montardon is the engineer in charge. Work will soon commence on dams, etc., necessary to develop 10,000 hp.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅝@12¾c; Lake, 12¾@12⅞c.; casting, 12½@12⅝.

The annual stockholders' meeting of the Chicago City Railway Company will be held in Chicago, February 16.

The Minneapolis General Electric Company has declared a dividend of $3 per share on its preferred stock, payable February 1.

The Chicago & Milwaukee Electric Railroad closed the year with a gross gain of 53 per cent. and a net gain of 75 per cent.

The Edison Electric Illuminating Company, of Boston, has declared a 2½ per cent. quarterly dividend, payable February 1.

The Chicago Edison Company has declared a regular quarterly dividend of 2 per cent, payable February 1, to holders of record January 23.

Another suit has been brought against the American Telephone & Telegraph Company on a patent involving the long distance transmission.

An Electric Storage Battery director says the 1903 year's earnings ran about $4,000,000, the largest business the company ever did, and that 10 per cent. can be shown earned on the stock.

The Butte (Mont.) Electric & Power Company declared a regular quarterly dividend of 1¼ per cent on its preferred stock, payable February 1. Books close January 28 and re-open February 2.

Judge Grosscup made no announcement before convening court in Chicago on Monday, concerning when he would decide upon the North Chicago dividend rate. While it is popular belief that the dividend will be 1¼ per cent., there is doubt in the minds of some as to whether or not such can be paid.

Interborough Rapid Transit, of New York, which showed considerable activity at the close of last week, netting 8¼ points gain for the week, showed increased strength Monday. About 1,000 shares were traded in, the price reaching 103½, and it closed at 103, a net advance of 2½.

The Chicago City Railway franchise extension will come before the city council January 25. No change looking toward municipal ownership will be allowed to enter the measure. The only question is that of compensation to the city. Ten per cent. of the gross receipts seems to be the most favored amount.

The Illinois Telephone and Telegraph Company filed for record with the County Recorder in Chicago on Monday a bill of sale for all its property, including tunnels, tracks, telephone cables and automatic switchboard appliances and telephone system. The bill of sale runs to the Illinois Tunnel Company, an Illinois corporation recently chartered, with an authorized capital of $30,000,000 and the power to issue as much more in bonds. Accompanying the bill of sale there was also filed for record a trust deed for $30,000,000 on the assets of the new corporation to secure a bond issue.

The New Jersey & Hudson River Railway & Ferry Company, which operates the ferry between the foot of West 130th street, New York, and Edgewater, N. J., and the electric railway from the New Jersey ferry terminal though Fort Lee, Englewood and Hackensack to Paterson, has just secured control of the Hudson River Traction Company, which owns the railway running south from Hackensack to the outskirts of Newark. An arrangement has also just been concluded between this company and the Public Service Corporation, whereby the Hudson River Traction Company's cars will be run through, without change, to Newark and Passaic

ELECTRICAL STOOK QUOTATIONS.

Name.	Closing price Jan. 18
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	143
Metropolitan Street Railway	122¼
Metropolitan Securities	89½
Ninth Avenue	200
Third Avenue	123
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	50
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	269
Philadelphia.	
Consolidated Traction of New Jersey	65⅜
Philadelphia Traction	97⅝
Union Traction, $17.50 paid	46⅞
Boston.	
Boston Elevated, full paid	140
West End Street, com	90
do. do. do. pref	110
Chicago.	
City Railway	165
North Chicago	87
Union Traction, com	6⅝
do. do. pref	32½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	21
do. do. pref	50
Electric Lead Reduction	⅞
Electric Vehicle, com	09
do. do. pref	14
Westinghouse, com	170
do. pref	192
General Electric	174
Boston.	
Edison Electric Illuminating	237
General Electric	174
Massachusetts Electric Companies, com	23¼
do. do. do. pref	78¾
Westinghouse Electric & Mfg., com	83½
do. do. do. pref	92
Chicago.	
Chicago Edison	154
National Carbon, com	26½
do. do. pref	95
Philadelphia.	
Electric Company of America	8½
Electric Storage Battery, com	58
do. do. do. pref	58
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	125½
Western Telephone Company	8
New England Telephone Company	121
New York.	
American Telegraph & Cable Company	86¼
Commercial Cable Company	183½
Mexican Telephone Company	1⅝
New York & New Jersey Telephone Company	140
Postal Telegraph Cable Company	....
Western Union Telegraph Company	87½
Miscellaneous.	
Chicago Telephone Company	120
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	26½
Consolidated Car Heating	66
Standard Underground Cable	220

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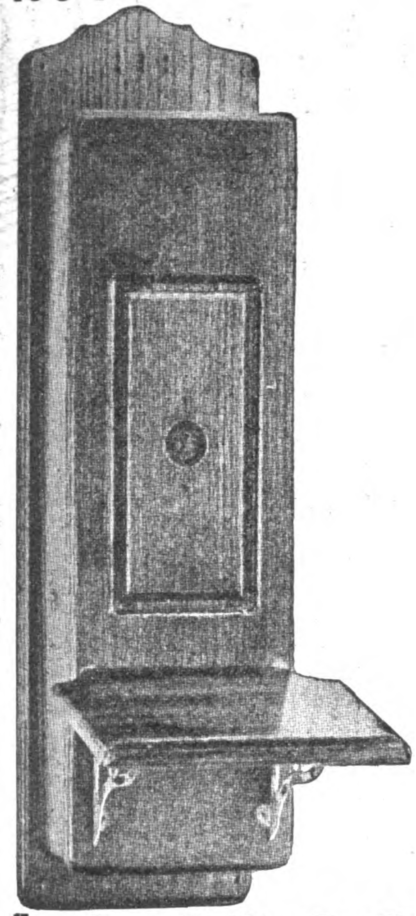


WE CAN ACCURATELY DRILL THEM FOR YOU SO THAT THEY ARE ALL READY FOR THE ASSEMBLING OF THE METAL PARTS. SEND US YOUR SPECIFICATIONS AND LET US QUOTE YOU.

Our Specialty is

High Grade Finish and Accurate Work.

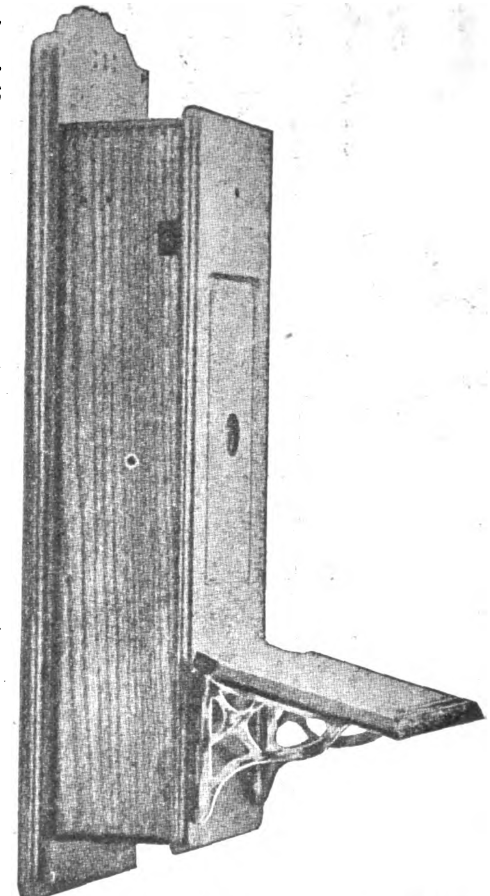
These two cuts show our new Compact Cabinet with nickel-plated brackets supporting the paper shelf. The paper shelf and nickel-plated brackets are removed in shipping. Doing this saves room, avoids scratching, and facilitates shipping.

The nickle-plated brackets make a handsome contrast with the highly finished quarter-sawed oak front and paper shelf.

We Can Furnish These Cabinets All Drilled Ready for the Working Parts.

In addition to the above cabinet, we make all of the standard styles including

CENTRAL ENERGY, MAGNETO BOXES, CABINETS FOR RESIDENCE PHONES, ETC.



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CONTENTS.

EDITORIAL NOTES.

The Northwestern Electrical Association Convention.

The convention held last week in Milwaukee by the Northwestern Electrical Association was replete with good things. A number of valuable papers on up-to-date subjects were read and thoroughly discussed, and an interesting and instructive lecture on radium was delivered by Prof. R. A. Milliken.

The president's address with the proceedings will be found on another page of this issue. The convention wisely decided to hold its midsummer meeting in St. Louis in conjunction with other electrical associations who will assemble at the Exposition in September.

We will print the most interesting papers read at the Milwaukee meeting in early issues of ELECTRICITY.

* * *

High-Speed Trials in this Country.

The high speed railway trials which have been going on for some time at Zossen, in Germany, and in which a speed of about 130 miles an hour has been obtained, are, according to the latest reports, likely to be duplicated in this country.

The New York Central Railroad assisted by one of the leading electrical manufacturing companies will, in all probability, undertake in the near future a series of speed tests with electric locomotives.

At a recent conference in Schenectady, N. Y., of the railroad officials and of several engineers representing the manufacturing concern the question of the tests was gone into quite thoroughly.

The party inspected the apparatus being constructed for the electrical equipment of the New York City terminal of the railroad, and also the stretch of the Central tracks near Schenectady where the proposed speed tests are to be held. The railroad company has just completed a detour of the city for the use of its freight trains. This will leave idle the present freight tracks, a well built stretch about eleven miles in length, and it is planned to use these two tracks for the tests of new electric locomotives.

One of the engineers at the conference is reported as saying:

"It is believed that the new apparatus being built for the New York Central Railroad will be able to attain a speed of more than 100 miles an hour. These locomotives will at least beat the record of 65 miles an hour made on the private tracks of the General Electric Company last summer. The Electric Company officials are confident the records made at Zossen will be equalled, if not beaten, by apparatus constructed in this country."

If these high speed trials come off, the results will be watched with interest by the electrical and railroad world.

* * *

Another Railroad Safety Device.

We have frequently referred in these columns to various devices that have been brought out to prevent railway accidents, more especially on roads making use of the third-rail. A resident of Rutland, Vt., has recently patented a block signaling device which he believes will make impossible such disasters as occurred in the Park avenue tunnel in this city. In fact, the inventor declares that his system will practically eliminate collisions of any kind on any road. From this it will be seen that the gentleman is nothing if not optimistic.

The invention provides for an electric block system by which it is impossible for more than one train to be upon a single

block at the same time. This is accomplished by setting track signals and flashing danger lights in the face of the locomotive engineer. Unlike several such schemes, the current is not obtained from a storage battery. Instead the power comes from track circuits placed between the rails.

When an engine enters a block a shoe underneath strikes the contact rail in which the power lies. This completes two circuits and instantly sets electric light signals wherever placed. The current passes to lamps in the cab, flashing a red light in the face of the driver and warning him of danger. Each block is controlled by the one preceding, so it is impossible for one train that is following another to come closer than the distance of one block without the engineer receiving two warning signals. One is a semaphore at the side of the track and the other is in the cab in front of his face. The warnings are the same whether the train is moving backward or forward.

An extra precaution is a pilot lamp which indicates whether the system is in perfect operation. If this lamp burns then the current is on; if it goes out it shows that there is something wrong with the current.

A daily paper, commenting on the system, states that one of the great advantages is that the engine driver has no levers to work, no mechanism to operate, and further does not have to depend upon man for his warnings. He simply has to keep his eyes open.

But here would seem to be the weak point. An engine driver does not always *keep his eyes open.* Another invention which automatically applies the brakes in case of danger, whether the engineer is awake or asleep would seem to be the better.

* * *

Electric Towing Device for Champlain Canal.

It looks very much as though the Champlain Canal might in the near future be equipped with an electric towing device. The New York State Superintendent of Public Works in his annual report just issued speaks as though in many respects he favors the scheme. A company that experimented for some time at Schenectady, N. Y., last fall with an electric towing device, has offered to equip the entire canal with its patent system. The work is to be done at the expense of the company, and it demands in return the exclusive right to maintain its system on the canals.

The Superintendent of Public Works in his report is cautious in giving his official approval to the plans of the company. He says he cannot indorse its offer to extend its proposed monopoly to the entire canal system, "because of the construction that might be placed upon such act by the public," and he adds that he has been "nearly convinced" by "careful consideration" that it should be let in on the Champlain Canal.

There is no doubt but what electric towing should be adopted on the canals, but it is questionable whether any one company controlling a certain device should have a monopoly.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The Berlin, Germany, street railroads in 1903 carried over 300,000,000 persons, exceeding all previous records.

The General Electric Company is expected shortly to make an announcement of a development in alternating current work which will be of a revolutionary character in the electrification of steam railways.

What is claimed to be the richest radium-bearing earth in the world has been discovered in the Llano gold and coal fields, 115 miles north of Austin, Tex.

The Weather Bureau of the United States Department of Agriculture has established on Governor's Island a storm warning display station equipped with high power electric lights. Hereafter all storm warnings, flags by day and lights by night, will be displayed at that point.

In a recent article on steam ferries in this country, *Engineering*, of London, says: "On the Hudson River thousands of *railway carriages* are conveyed on large lighters pulled by ordinary tugboats. The italics are ours. We would call them freight cars.

The 183d meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West 55th street, on Friday evening, January 29, at 8:15 o'clock. The following papers will be presented at this meeting: "The Alternating Current Railway Motor," by Charles P. Steinmetz. "Speed Torque Characteristics of the Single-Phase Repulsion Motor," by Walter I. Slichter. These two papers relate to the latest and most interesting advance in electrical engineering as applied to traction purposes. Prof. Steinmetz's paper deals with the subject from a simple mathematical point of view, and Mr. Slichter's paper from a more general point of view. It is expected that these two papers will provoke an exceptionally interesting discussion.

Engineers of Atlanta, Ga., will soon form a branch of the American Institute of Electrical Engineers.

At the annual convention of the United Electrical Contractors' Association of New York State, held last week at the Building Trades Club in this city, the following officers were elected to serve for a year: President, Marshal L. Burns, Troy; vice-president, James R. Strong, New York; secretary, Frederick Fish, Rochester, and treasurer, J. C. Stearns, Buffalo.

The *St. James' Gazette* of London calls the attention of professional neologists to the present and rather pressing need of some new verbs. "We want," it says, "popular verbs for several operations introduced by modern science. The X-rays, the Finsen treatment for lupus, the operation of radium for cancer, and what not - what are the words for these? A man is guillotined or hanged, his leg is amputated; he is trepanned. What is it when he is rayed, Finsened, radiumed? We still want a wireless word. 'Marconigram,' which was suggested, seems to have died a natural death. What is the synonym for telephone when one speaks over the instrument to which a phonograph is attached? And have we finally agreed that 'motor' is the verb to travel by automobile?"

At a regular meeting lately held by the St. Louis Electrical Contractors' Association the following officers were elected for the ensuing year: President, E. C. Van-Nort; vice-president, R. Routgell; secretary, Edward T. Cooke; treasurer, William Carroa; sergeant-at-arms, J. H. Lucas.

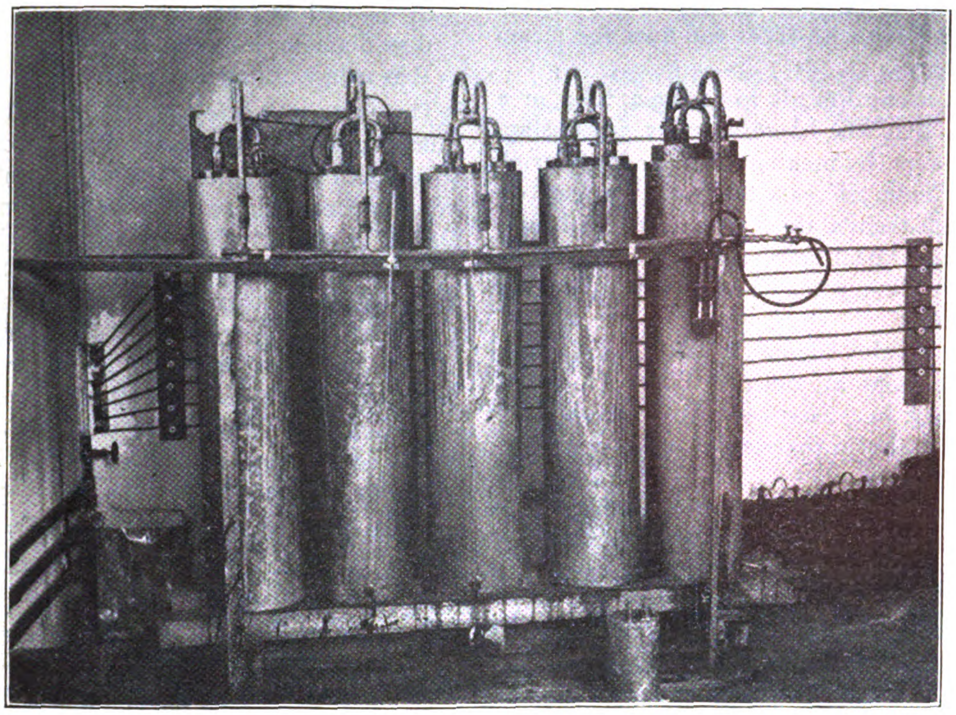
This (Wednesday) evening before the New York Electrical Society Prof. W. G. Goldsborough will discuss the use of electricity in connection with exposition work since the introduction of electric power, starting with the very earliest and most primitive applications. The evolution which has taken place in the making of exhibit installations will be brought out, leading up, as it will, to an estimate of the installations which will be made in the Electricity Building at St. Louis. A general view of the development of electric decorative effects in connection with the interior and exterior illumination of exposition buildings will also be given. The lecture will be profusely illustrated by lantern slides.

THE SCHOOP ELECTROLYZING ACCUMULATOR.

BY EMILE GUARINI.

The above title is a very appropriate one for the invention which is about to be described. The Schoop electrolyzer, after being in operation a short time, differs from the others by the formation of peroxide of lead at the positive pole, making of it an accumulator of small capacity, which fact gives it a certain superiority over all the other kinds of electrolyzers for the industrial production of oxygen and hydrogen gases, because its production of these gases is much greater per kilowatt hour used than is furnished by any of the other processes. Furthermore, it is made by the firm of Kolner A. K. Kumulatoren-Werke, Gottfried-Hagen, one of the oldest German dealers in accumulators. The Schoop accumulator, as manufactured by the firm, possesses in addition to its advantages none of the defects found in others of its kind. It contains no diaphragm, as is usually employed for the separation of the two gases. It consists of a vat or cell which is lined on the inside with lead, and filled with a solution of sulphuric acid having a density of 1.23. There are two curved lead tubes, covered with insulating material on the outside, or two group of tubes, mounted in parallel, which lead into the cell. These tubes are enlarged at their extremities, giving them a bell-shape, so as to present a larger surface for the passage of the current. When these enlarged diameters of the tubes amount to 90 mm. the current, which has a constant flow, is 25 amperes, and the production of oxygen and hydrogen is then respectively 5.22 and 10.44 liters per hour.

The gas pressures depend on the length of these tube electrodes. The pressure in the apparatus, as it is constructed at the present time, is from 60 to 70 cm. of water, and thus need not be mechanically compressed for direct use. The electrical tension is 3.3 to 3.6 volts. Should a 110-volt current be used 30 electrolyzers may be set up in series. The maintenance consists in filling the cells each week with pure water. The discharge pipes are connected to the collecting pipes by means of rubber hose. Usually pressure gauges are fitted to the pipes before they enter the gas holders. While the gases produced are very pure it is considered necessary to wash the oxygen with sulphuric acid for the purpose of taking out what little aqueous vapor it may contain.



View of a Battery Composed of Five Elements of the Schoop Electrolyzing Accumulators.

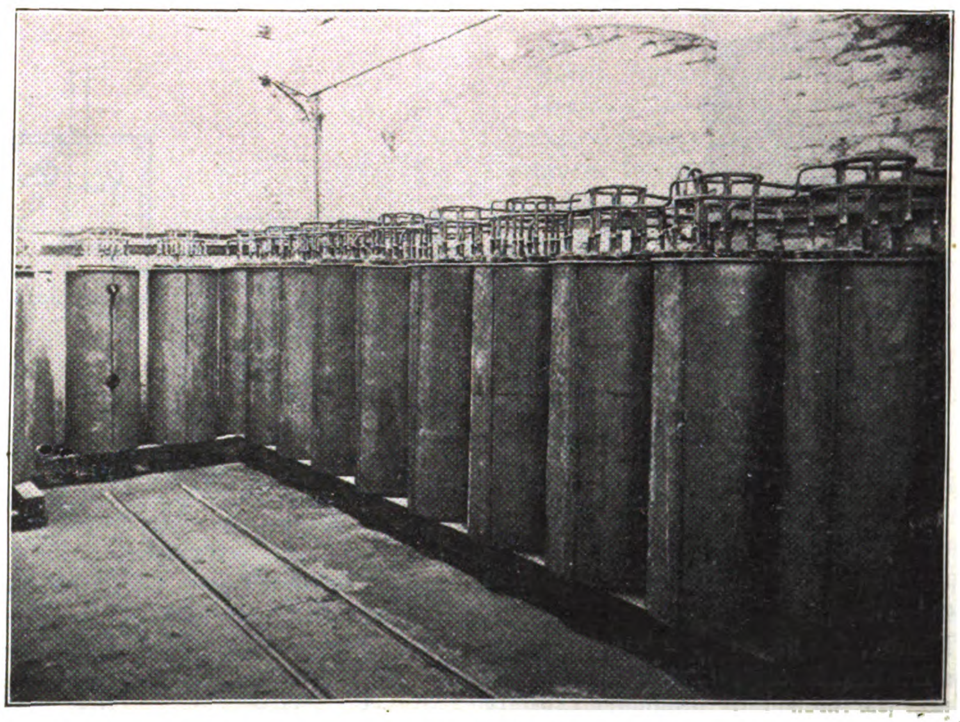
The inventor and the manufacturers claim for this apparatus the following advantages: Absolute sureness of its operation, the exclusion of all danger of explosion, absence of diaphragms and consequently no repairs, an almost chemical purity of the gases, and a reduction in the expense of operation.

From tests already made the oxygen contains impurities of only 1 per cent., that is, 0.8 per cent. of aqueous vapor and 0.2 per cent. of hydrogen; the hydrogen gas produced contains from 2 to 2½ per cent. of foreign gases.

One horse power hour furnishes 48.75 liters of oxygen and 97.5 liters of hydrogen, consequently 6.2 to 6.8 horse power hours on the average is required to produce one cubic meter of the combined oxygen and hydrogen gases.

If we compare the production from this apparatus with that produced by the Garuti process we obtain the following:

Process.	Oxygen in liters.	Hydrogen in liters.
Garuti......	0.083	0.1666
Schoop......	0.067	0.13



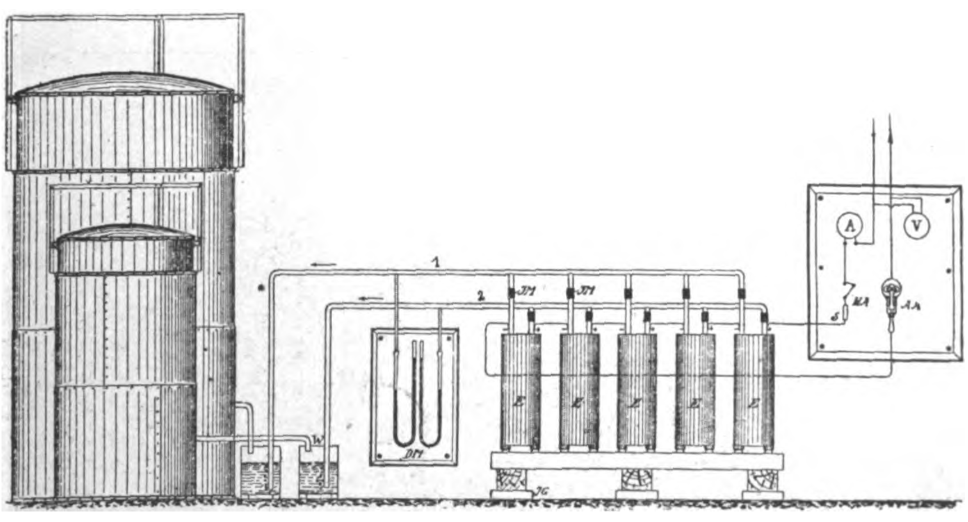
A View of a Large Schoop Electrolyzing Accumulator Battery.

In the meantime it is interesting to note that the Garuti process has advantages over the Schoop process, in that the average of the current is 2.4 volts for the first

and 3.3 to 3.6 volts for the latter, but on the other hand the Schoop process has the advantage over the Garuti in the amperage used. It is further stated that in the production of a cubic meter of the combined gases the consumption of energy in the Schoop process is 6.2 to 6.8 horse power hours and in the Garuti process 5.43 hp. hours.

Soldering Accumulator Connections by Means of Oxy-hydrogen Gas Flame, as Produced by the Schoop Process.

Finally, the process is interesting from the fact that it compensates to a certain extent for the lack of producing capacity which might be imputed to it as well as for other reasons. There is no doubt but that it will contribute to the growth of those industrial processes which require oxygen and hydrogen and which have already commenced to gain a footing.



Diagrammatic View of a Schoop Electrolyzing Installation.

E—Electrolyzer. A—Ampere meter. V—Voltmeter. HA—Hand circuit breaker. AA—Automatic circuit breaker. B—Fuse. IM—Insulating sleeve. DM—Pressure gauge. 1—Hydrogen. 2—Oxygen.

COLLAPSING PRESSURE OF TUBES AND FLUES.

ARTICLE III.

BY W. H. WAKEMAN.

Several years ago the United States Board of Supervising Inspectors adopted the following rules and formula for use in connection with tubes and flues for steam boilers.

It is not difficult to design a tube or a flue that will be safe under any desired pressure, by making it of thick material, but inasmuch as a thin tube is more efficient than a thick one (because it will transmit heat more readily), it should be as thin as a proper regard for safety will admit.

The rules adopted by the United States Inspectors are not only based on correct theory, but have been proved by experiment, also in practice, and are not found wanting.

Some of these formulas are taken from what is known as Lloyd's Register (English authority), but others are apparently original.

Tubes 4 inches and less in diameter and flues not exceeding 6 inches in diameter may be made plain, of any required length, and are allowed to carry 225 pounds pressure per square inch, provided they are properly made of material not less than the thickness prescribed by the following table:

Outside diameter.	Thickness.
2 inches	.095 inch.
2¼ "	.095 "
2½ "	.109 "
2¾ "	.109 "
3 "	.109 "
3¼ "	.120 "
3½ "	.120 "
3¾ "	.120 "
4 "	.134 "
4½ "	.134 "
5 "	.134 "
6 "	.165 "

For flues from 7 to 12 inches inclusive in diameter, and all lengths found in practice, the following formula applies:

$$\frac{806{,}300 \times t^2}{L \times d \times 3} = P.$$

t = thickness in decimals of an inch.
L = length in feet.
d = diameter in inches.
P = safe working pressure.

The factor of safety is evidently 3 in this case, which appears small when compared with the higher factors frequently used in determining safe loads for machinery, etc., but when we remember that for boiler shells the United States Supervising Inspectors allow less than 4 as a factor of safety, when the strength of riveted joint is considered, the factor allowed for flues nearly agrees with it.

Taking flues 16 feet long as before and applying this formula gives the following safe working pressure:

7 inch flue	.24 inch thick,	138 pounds.
8 "	" .26 "	" 142 "
9 "	" .27 "	" 136 "
10 "	" .28 "	" 131 "
11 "	" .29 "	" 128 "
12 "	" .31 "	" 134 "

Of course the collapsing pressure may be found in each case by multiplying the above results by 3, or it may be calculated directly by omitting 3 in the formula.

The next formula may be used to determine the diameter of flue, when the thickness of material, length of flue and safe working pressure are given:

$$\frac{806{,}300 \times t^2}{L \times P \times 3} = d.$$

t = thickness in decimals of an inch.
L = length in feet.
P = safe working pressure.
d = diameter in inches.

Taking for illustration a flue to be made of iron .24 inch thick, length 16 feet, to carry 138 pounds, we find that it may be

$$\frac{806{,}300 \times .24^2}{16 \times 138 \times 3} = 7 \text{ inches.}$$

The required thickness of material may be determined by this formula:

$$\sqrt{\frac{L \times d \times P \times 3}{806{,}300}} = t.$$

The letters refer to the dimensions already explained. Applying it to a case where a flue is to be 16 feet long, 8 inches in diameter, to carry a pressure of 142 pounds, gives the following result:

$$\sqrt{\frac{16 \times 8 \times 142 \times 3}{806{,}300}} = .26 \text{ inch thick.}$$

Where the thickness, diameter and pressure are given the suitable length is determined by the next formula in which the

letters refer to data previously explained:

$$\frac{806,300 \times t^2}{d \times 136 \times 3} = L.$$

If we wish to construct a flue of iron .27 inch thick, 9 inches in diameter, to carry 136 pounds pressure, the required length is easily obtained:

$$\frac{806,300 \times .27^2}{9 \times 136 \times 3} = 16 \text{ feet long.}$$

The four preceding formulas are suitable for application to plain flues of any reasonable length and for the stated diameters (although their limitations are not sharply defined), but if we apply the first of this group to determine the safe working pressure for a flue made of iron .5 inch thick, 20 feet long and 42 inches in diameter, the result is only 26 pounds.

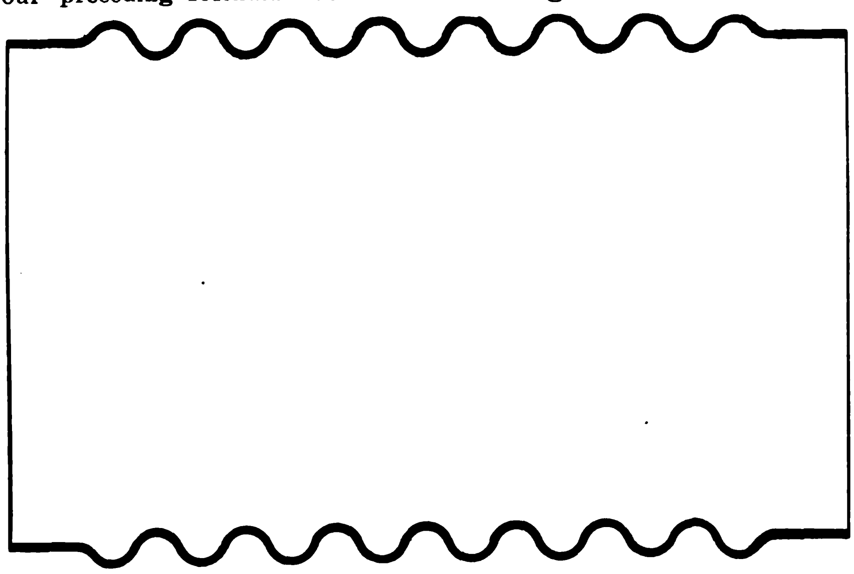


FIG 2.

Such a low pressure is useless for modern practice, but of course the flue would not be made stronger by substituting another formula, therefore measures must be taken for making the flue stronger. This is accomplished by making it in corrugated form as illustrated in Fig. 2, which is known as the Fox furnace flue or Fig. 3, which is the Morison suspension furnace flue. It will be noted that these corrugations add much to the strength of the flue, and another important and valuable feature is that when calculating their safe working pressure it is not necessary to take the length into consideration because the continued corrugations make it independent of the length.

For large flues the corrugations must be not less than 1.5 inches deep, and they must be continued to within 6 inches of the end. Care must always be taken to avoid reducing the thickness of material when making this style of flue.

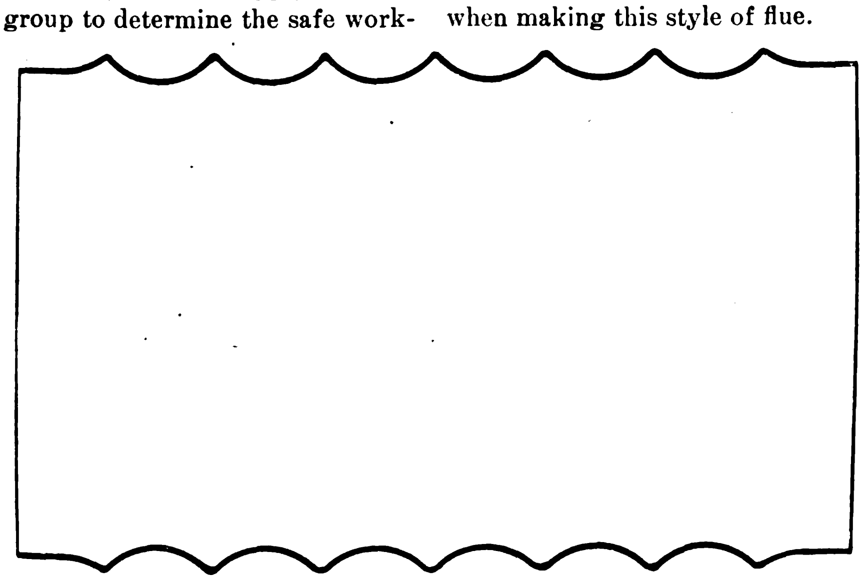


FIG. 3.

When calculating the safe working pressure the average diameter is to be taken. The following formula is given for determining the safe working pressure of corrugated flues:

$$\frac{14,000}{d} \times t = P.$$

d = diameter in inches.
t = thickness in decimals of an inch.
P = safe working pressure.

If a flue is 42 inches in diameter, made of iron .5 inch thick, its safe working pressure is

$$\frac{14,000}{42} \times .5 = 166.5 \text{ pounds.}$$

To determine the diameter of flue for a given pressure and thickness of plate the following applies:

$$\frac{14,000}{P} \times t = d.$$

$$\frac{14,000}{166.5} \times .5 = 42 \text{ inches in diameter.}$$

If the diameter of corrugated flue, and the steam pressure to be obtained, are given, the following formula may be used to determine the necessary thickness of material:

$$\frac{d \times P}{14,000} = t.$$

Applying it to the 42 inch flue to carry 166.5 pounds pressure shows that it must be at least

$$\frac{42 \times 166.5}{14,000} = .5 \text{ inch thick}$$

If large flues that are to carry high pressures are not corrugated they must be made in sections, for experiments have demonstrated that when so designed and constructed it is proper and safe to use the length of section, the same as if it were the total length of flue.

A NEW SURFACE-CONTACT SYSTEM FOR ELECTRIC TRAMWAYS.*

A demonstration of the "G. B." surface contact system was recently given at Ilford, England. As shown in the illustrations, the bare line conductor, consisting of stranded galvanized iron cable, is drawn through plain butt-jointed 5 inch stoneware pipes, and is suspended at convenient intervals by vitrified clay insulators. If found necessary, the electric conductivity of the cable may be raised by including a copper conductor. The galvanized steel pivots of the insulators are carried through one side of the glazed pipe conduit, and are all electrically connected together and with the track rails. This is to insure a direct path to the rails for any possible leakage current from the cable, thus practically preventing a serious difference in pressure between the studs and the rails due to surface leakage on the clay insulators. Although the total depth of excavation does not exceed 19 inches in standard practice, even this depth may be reduced by 6 inches or 7 inches for special purposes. As seen from Fig. 2, the whole conduit is embedded in concrete.

*From the "Electrician," London.

Access boxes, placed at intervals of from 200 yards to 400 yards along the track, consist of cast-iron bodies with manganese covers. The two cable ends, entering a box at opposite sides, are led to terminal bars, mounted on insulators within the box. Drainage pipes, leading from the

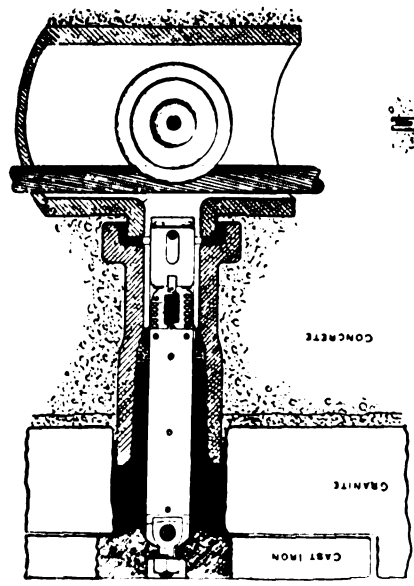


FIG. 1.—CROSS-SECTION AND LONGITUDINAL SECTION OF STUD.

bottom of these boxes, conduct away any water which may accumulate in the earthenware pipes. Every 7 feet 6 inches —corresponding to the distance between studs—a short vertical earthenware tube is cemented to the main horizontal pipe (Fig. 1). Into this vertical portion of the pipe system the laminated stalk of the stud is let, the upper part of the intervening space between it and the tube being subsequently filled up with bitumen, a packing of jute yarn preventing this material from falling through. A loosely fitting contact plunger, consisting of a laminated body and a carbon contact piece, slides in the brass-lined fork of the stalk, as indicated in Fig. 1. It is electrically connected to the stalk by flexible copper conductors and is held up from the cable against the force of gravity by an insulated phosphor-bronze spring, the separating distance being about $\frac{5}{16}$ inch. The stalk is connected to the cast-iron stud by a somewhat flexible joint, but this does not prevent its making good electrical and magnetic contact. A recessed granite block receives the stud which is level with the track and whose surface measures 2½ inches by 14 inches. By directing the flame of a blow-pipe against the stud, the bitumen beneath is made to melt and the stud as a whole may be withdrawn, this operation occupying, it is said, but seven minutes. In addition to the ordinary standard equipment, each car is provided with a magnet rigidly suspended beneath the car and a battery of accumulators. It may be mentioned that the accumulators serve for starting only, being charged up during ordinary running. One pole of the magnet is in the form of two parallel iron bars, and is suspended at a distance of about 2 inches above the center of the track. Between these two bars are a number of iron tongues (Fig. 2) suspended by springs, but free to move a considerable distance up and down. These are all connected at their lower ends by one flat chain belt (not shown in the illustration), about ⅜ inch wide, which is kept parallel to the track at a distance of approximately ⅝ inch by the springs and tongues referred to. In order to have a continuous supply of current, the belt is made longer than the distance between any two studs.

As the car comes over each stud both the flexible chain belt and the sliding

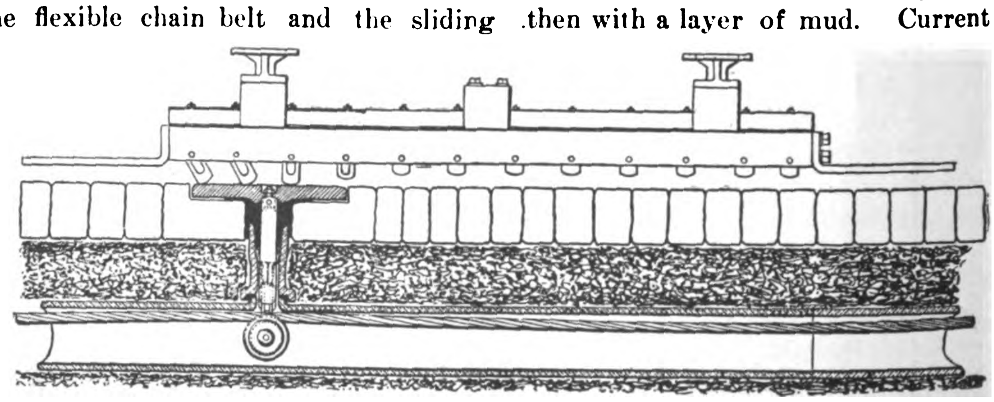


FIG. 2.—CURRENT-COLLECTING DEVICE.

plunger are attracted downwards, and the former, on coming in contact with the stud, completes the electric circuit. It is stated that the net force with which the plunger, weighing 6½ ounces, is drawn downwards, is equivalent to the weight of 6 ounces at the beginning, increasing to about 16 ounces when the carbon contact touches the cable. If a non-magnetic cable is used, the figures are given as 3 ounces and 6 ounces respectively.

The gauge of the trial track, which was one-fifth mile in length, was 4 feet 8½ inches, and the paving consisted of granite in bitumen, granite in cement and hard wood. The steepest gradient was 1 in 32, the sharpest curve having a radius of 54 feet. A double-deck car, with a total seating capacity for 54 passengers and fitted with two 25 hp. Walker motors and Dick-Kerr series-parallel controllers had been fitted up with the auxiliary equipment necessary for the new surface-contact system. Its weight, fully equipped, was stated to be 10 tons. When running empty round the track, the current taken by the car varied between 20 and 35 amperes, the latter current corresponding to the steepest incline, the pressure being kept constant at 500 volts. The leakage of the experimental track was measured and found to be 0.05 ampere; and it may be mentioned that the ground upon which the track was laid was very moist. When a bucket of water was thrown on the track, the leakage of current between the rails and a live stud began with 0.5 ampere, and then fell gradually. In order to show the current-carrying capacity of the contacts, the car brakes were applied and the car set in motion. By this means a current of about 95 amperes was taken through the studs.

The energy absorbed for exciting the magnets was measured during the tests, and amounted to 325 watts. On one occasion, a stud was thickly smeared with mud, and the car slowly brought over it; this, however, did not prevent current being successfully picked up. Another stud was covered with a newspaper, and then with a layer of mud. Current was also picked up in this case, that portion of the paper only being torn by the collecting chain which was directly above the stud.

In case a stud should remain alive after the chain belt has passed, the supply is interrupted by means of chains, fixed to the end of the car and trailing on the track, coming in contact with the live stud and causing a maximum cut-out on the car to operate.

The metric system has been adopted by the Parliament of New Zealand.

ELECTRICAL STATION PRACTICE.

ARTICLE XXI.

BY W. H. RADCLIFFE.

Alternating current voltmeters although similar in outward appearance to direct current voltmeters, are designed to operate on a different principle. This fact would impress itself very noticeably were one attempting to measure the pressure of an alternating current with a voltmeter of the direct current type, for no matter how high the voltage there would be no deflection of the pointer owing to the rapid reversals of the alternating current.

Voltmeters of the alternating current type depend for their operation on the magnetic effect of the current alone, so that they never contain permanent magnets. In the matter of details, however, they differ considerably according to the manufacturer. In one type there are two coils of wire wound in opposite directions on cylindrical spools which are mounted end to end, and these serve in place of the permanent horseshoe magnets in the instruments previously described. Between the spools in each meter is pivoted a fine wire coil which is provided with pointer and springs as in the case of the direct current voltmeter. The three coils are joined in series with each other and then in series with a high resistance wire such as was employed in the direct current instrument. The lead from the resistance wire runs directly to the left-hand binding post, while the remaining lead from the coils is usually connected with an adjustable resistance used for temperature corrections, and then through a key to the right-hand binding post.

It makes now but little difference in which direction the current is flowing since the relation between the lines of force of the two fixed coils and those of the movable coil is always such as to deflect the pointer in the same direction over the scale. The reason for this lies in the fact that the three coils are connected in series, so that when the current changes direction in one of them it changes direction in all three. The reversals of an alternating current are always so rapid that there is practically the same effect produced in the meter as would be done by a direct current of nearly the same strength; there is therefore a steady deflection of the pointer at all times the meter is connected in circuit. From what has just been stated it is evident that a voltmeter thus designed to measure the pressure in an alternating current circuit would also be capable of measuring the voltage in a direct current circuit, although, as previously mentioned, a direct current voltmeter would not measure the pressure in an alternating current circuit.

It has been stated there is usually introduced in this type of alternating current voltmeter an adjustable resistance for temperature corrections. This resistance is varied by turning a knob to which an index projecting over a circular scale graduated in Centigrade degrees is attached. The resistance itself is contained within the case of the meter, but the knob, index and scale are mounted on the face of the instrument. A small Centigrade thermometer is also mounted on the face of the meter to aid in the adjustment. To correct for a variation in the resistance of the voltmeter due to change in temperature, it is merely to note the reading on the thermometer and then turn the knob until the index points to this same number of degrees on the scale beneath it. This movement of the knob cuts in or out of the voltmeter circuit the necessary amount of the adjustable resistance to compensate for the change due to a variation in the atmospheric temperature.

In another type of alternating current voltmeters largely used, a coil of fine wire is connected between the terminals of the meter, and the magnetic attraction produced by a current passing through this coil of wire for a laminated iron core or plunger to which the pointer is attached, is a measure of the voltage applied to the terminals of the instrument. As in the other meters described, springs are here also used; one of them is fastened to the plunger and draws it, together with the pointer attached, back to the zero position where there is no current and, therefore, no voltage applied.

The capacities of the alternating current voltmeters in general use are 3, 7.5, 10, 12, 15, 20, 60, 75, 120, 150, 300 and 600 volts, but these capacities may each be increased by the use of a multiplier in the same manner as previously explained for direct current voltmeters. Station voltmeters are usually bolted to the switchboard by means of four iron supports mounted on the back of the instrument; two of these are fastened toward each side of the case. Under certain conditions, however, as in paralleling of alternators, it is convenient to have the alternating current voltmeters mounted on swinging brackets at the side of the switchboards. The voltmeter may then be swung around in any desired direction so as to enable the attendant to keep informed of the voltage while switching in each additional alternator.

The ammeter or instrument for measuring the current strength has not as yet been considered in detail, so the direct current type of this meter will now be taken up. The outward appearance of a direct current ammeter is not dissimilar from a direct current voltmeter except that the binding posts are larger, and the portable instruments are not provided with keys. Within the metal case there are also many points of similarity. In the Weston direct current portable ammeter there is a permanent horseshoe magnet of precisely the same shape and size as the one described in connection with the Weston direct current portable voltmeter. There is also a fine wire coil to which a pointer and springs are attached as in the previous case, and a soft iron core is permanently fixed in the same manner within this coil for strengthening the magnetic circuits of the horseshoe magnet and of the fine wire coil. Owing to the different positions occupied by the two instruments in circuit, however, the remaining details in their construction differ considerably. The ammeter must necessarily be connected in series with the circuit to measure the current and so must contain a low resistance else the current will be needlessly wasted thereby, whereas a voltmeter being bridged across the circuit in order to obtain its pressure must contain a high resistance so as to shunt as little of the current as possible.

The circuit through a direct current ammeter is as follows: From one of the binding posts a lead connects with a copper plate. Directly beneath this plate and parallel to it is mounted a second copper plate similar in every respect to the one previously mentioned; this plate is also joined by a lead with the remaining binding post of the meter. Connecting the one plate with the other are a number of short circuits of fine insulated wire in parallel, which for support are wrapped non-inductively around the yoke of the permanent horseshoe magnet. The fine wire coil carrying the pointer is also electrically connected across these two plates, and the scale over which the pointer projects is graduated after so proportioning the number of the auxiliary parallel circuits between the plates as to allow the necessary amounts of current through the fine wire coil to produce the proper deflections. The atmospheric temperature correction for this type of ammeter is, for a range of 35 degrees above or below 70 degrees Fahrenheit, less than 1 per cent. and may therefore be neglected.

Inasmuch as the entire current of the circuit must pass through the ammeter in order to be measured, conditions are favorable for the development of a considerable amount of heat within the in-

strument, and as this heat tends to increase the resistance of the interior wiring there is an error introduced which varies according to the strength of the current in amperes and the time during which it is passing through the meter. In ammeters whose capacities are .75, 5, 15 or 25 amperes the currents passing through the instruments are so small that although the meter be left in circuit for an indefinite length of time, the errors introduced in each case will be less than 1 per cent. and therefore negligible. In an ammeter having a capacity of 50 amperes, the error thus introduced will be less than 1 per cent. if connected continuously in circuit with a current not exceeding three-quarters this capacity. An ammeter of 100 amperes capacity may be used indefinitely in circuit with less than 1 per cent. error up to one-half its capacity, and for five minutes at three-quarters capacity without exceeding the 1 per cent. limit. The 150 scale ammeter may be left in circuit for an indefinite length of time at one-third its full capacity, and for three minutes at one-half its full capacity, with a negligible error. Ammeters of 200 and of 300 ampere capacities must not carry more than one quarter these respective number of amperes continuously if the readings are to have an accuracy within 1 per cent., nor more than one-half these respective number of amperes for three minutes if the same degree of accuracy is desired. In order to cut or shunt the ammeter out of circuit when not in use, it is customary when wiring the instrument in place to introduce a switch as a shunt across it; this switch is kept closed except when a measurement is being taken.

When currents larger than 300 amperes have to be measured, ammeter shunts are generally employed, although ammeters up to 500 amperes capacity are manufactured. An ammeter shunt consists of a number of strips of alloy mounted parallel to each other in two copper blocks. Each of the blocks contain two binding posts, one of which serves for the main conductor of the circuit and the other for a lead to the meter. The meter used in this connection is designed along the lines of a voltmeter, rather than those of an ammeter; in fact, the instrument might well be termed a low reading voltmeter, or a voltmeter in which the high resistance coil is replaced by one of low resistance. The meter is graduated by varying the length of the resistance coil until the deflections of the pointer on the scale of the instrument agree with the number of amperes passing in the main circuit as measured on another instrument. After the meter is once graduated, it is, of course, used only in connection with the shunt and a special pair of leads belonging to it, for measuring current.

The principal advantage of the ammeter shunt is that the strips of alloy of which it is composed being surrounded on all sides with air, radiates most easily any heat developed therein by the current, so that its resistance does not vary perceptibly with the number of amperes passing through it; therefore, the voltage operating a meter used in connection with the shunt is more directly proportional to the current than in most other ammeters. Owing to this fact, currents up to and including 10,000 amperes may accurately and easily be measured. In the handling of this meter it is important to guard against passing the current in the main circuit directly through it, that is without the use of the ammeter shunt, since the resistance of the meter is generally so low that the pointer will give a full scale deflection on less than the five-hundredth part of a volt across its terminals. It is well, therefore, always to wire a switch across it so that it may be shunted out of circuit when not in service.

Station ammeters of the direct current type must usually have capacities above 300 amperes, so the majority of them are used in connection with ammeter shunts. The meters themselves are then constructed on the principle of a low reading voltmeter as previously explained. The outward appearance of direct current station ammeters is not unlike that of direct current station voltmeters. The working parts are enclosed within a cast-iron case which, as before, acts as a shield guarding the instrument against magnetic influences of a foreign nature. There is also an opal glass scale illuminated from the rear by an incandescent lamp, but the normal index mentioned as a part of the station voltmeter is quite unnecessary in the case of a station ammeter. The meter is fastened to the switchboard by means of four iron supports attached to the back of the instrument in the same manner as to the station voltmeter.

Owing to the similarity between the construction and the principles of operation of direct current meters, many of the rules previously given for the handling of direct current voltmeters apply with equal force in the case of direct current ammeters. Those precautions to which special attention should be given are the following: An approximate idea of the number of amperes to be measured before introducing the ammeter in circuit. The proper direction of the current through the meter so that the pointer is deflected over the scale. The straightening of the pointer if more than two-tenths of a division off the zero mark. Securely fastening the wires or cables which connect the meter in circuit so that they will not, if pulled by accident, cause the meter to fall. Placing the instrument away from disturbing magnetic influences. Careful handling of the meter when moving it from place to place, or when setting it down. Reading deflections of the pointer to tenths of a division. In portable instruments, making use of the mirror for obtaining accurate readings, and tapping the case of the meter if the pointer has difficulty in coming to rest.

Ammeters which are not used in connection with shunts, and yet which are permanently connected in circuit at or near their maximum capacities, not only suffer in accuracy from the heat developed within their windings, as previously explained, but are also affected by any heat that may be generated at the contacts between the binding posts of the meters and the wires connecting therewith. To reduce as far as possible errors in the observations arising from the latter cause it is advisable to employ for the part of the circuit connecting with the meter, wires of a larger diameter than would actually be required for the number of amperes carried, or else to substitute for these wires cables without terminals; the latter conductors, owing to the relatively large amount of surface exposed to the air, afford a high degree of radiation and therefore maintain low temperatures at the points of connection.

THE INTERNATIONAL ELECTRICAL CONGRESS.

According to the present indications the International Electrical Congress, to be in session at St. Louis September 12-17, will be one of the most successful that has yet been held, both with respect to the number of adhesions and to the value of the transactions.

Up to date about 3,550 circulars letters of invitations to join the Congress have been issued to persons or associations in North America. From these 875 acceptances of membership have been received. About 350 similar circular letters of invitations have been recently sent to other countries. It is intended to issue in all about 5,000 invitation circular letters in American and about 6,000 in foreign countries, It is expected that many persons will join the Congress, both in America and abroad, who do not expect to attend the sessions in St. Louis, in order to secure a copy of the Transactions, which will form one and perhaps two

large octavo volumes. Collection of fees has commenced, and upon receipt of a fee the member will be forwarded a certificate of membership. The certificate is 8½ inches by 11 inches in size, and printed on heavy paper of excellent quality.

Recently 280 special letters of invitation have been issued on behalf of the committee of organization to prominent electricians and electrical engineers, signed by the president and the general secretary of the committee, requesting papers for the Congress in the various sections. Of these, 146 have been sent to foreign authors, and 134 to American authors. There has not been time to receive replies from more than a few foreign authors, but 21 acceptances have up to date been received from abroad, and 46 acceptances from North America. Sixty-seven papers have thus already been promised for the Congress, and the number is steadily increasing. A considerable further number of invitations to contribute papers have yet to be issued. It is hoped that the Congress will convene with a full programme in each section, and that at least half of the papers may be from foreign countries. According to the plans of the committee, papers for the Congress programme are specially invited, but papers voluntarily offered will be submitted to the officers of the sections to which the papers belong, and may be included in the programme by invitation at their request, if the subjects are desirable, and if the schedule allotted to each section will permit, it being the desire of the section officers to secure and offer the best possible programme and presentation.

Petitions from the Congress committee of organization and from the president of the American Institute of Electrical Engineers have been filed with the Department of State at Washington, through the Department of Commerce and Labor and the National Bureau of Standards, urging that the various foreign Governments should be invited to appoint official delegates to the Congress. The lists of such delegates to be invited is in accordance with the lists allotted to the various countries at the Paris Congress of 1900, and the Chicago Congress of 1893. Including the United States, the lists comprise 56 official delegates. Information has been received that these petitions have been granted, and that the State Department on December 17 last, instructed the diplomatic officers of the United States abroad to extend an invitation to foreign countries to be represented at the Congress by delegates.

Arrangements are being made with a view to perfecting plans of co-operation between the Congress and electrical societies and associations in various parts of the world. Invitations have already been extended to the Congress members to visit places of electrical interest on the journey to or from St. Louis.

The committee of organization of the Congress consists of Elihu Thomson, president; A. E. Kennelly, general secretary; W. D. Weaver, treasurer; Bion J. Arnold, vice-president and chairman of executive committee; C. F. Scott, Dr. S. W. Stratton, Prof. H. S. Carhart and Prof. W. E. Goldsborough, vice-presidents.

The following section officers have been appointed by the president and have done much work in organizing their sections:

Section A, General Theory—Prof. E. L. Nichols, Cornell University; Prof. H. T. Barnes, McGill University.

Section B, General Applications—Prof. C. P. Steinmetz, Schenectady; Prof. Samuel Sheldon, Brooklyn.

Section C, Electrochemistry—Prof. H. S. Carhart, University of Michigan; Carl Hering, Philadelphia.

Section D, Electric Power Transmission—C. F. Scott, Pittsburg; Dr. Louis Bell, Boston.

Section E, Electric Light and Distribution—J. W. Lieb, Jr., New York; G. S. Dunn, New York.

Section F, Electric Transportation—Dr. Louis Duncan, Massachusetts Institute of Technology; A. H. Armstrong, Schenectady.

Section G, Electric Communication—F. W. Jones, New York; Bancroft Gherardi, New York.

Section H, Electro-Therapeutics—Dr. W. J. Morton, New York; W. J. Jenks, New York.

All communications should be addressed to the general secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass.

National Electric Light Association.

One or the most interesting and valuable portions of the volume of Transactions which the National Electric Light Association is about to issue is the report with cuts in colors on decorative and sign lighting. If for nothing else the members are likely to prize this volume on receiving it. Mr. Arthur Williams, the reporter on the subject, has been appointed to take up the matter again this year in a second report, and proposes to handle the subject in a somewhat different manner, adding to illustrations the ideas and opinions of central station men concerning advertising signs, and selecting instances in which decorative lighting of that character has been productive of increased trade and revenue to the users. He is now collecting such data and all of our readers interested in the subject should communicate with him at the offices of the New York Edison Company.

NORTHWESTERN ELECTRICAL ASSOCIATION CONVENTION.

The Milwaukee Meeting Well Attended--A Number of Important Papers Read and Discussed—T. F. Grover, of Fond du Lac, Elected President.

The twelfth annual convention of the Northwestern Electrical Association was held at the Hotel Pfister, Milwaukee, Wis., Wednesday, Thursday and Friday, January 20, 21 and 22.

The convention was called to order at 12 o'clock on the opening day by President F. W. Bowen, and at the request of Secretary Mercein the delivery of the president's address was postponed until the afternoon session.

The secretary presented his report which was accepted, and the convention adjourned until 1:45 P.M.

WEDNESDAY AFTERNOON SESSION.

The convention was called to order at 1:50 P.M., and the president then read his address as follows:

PRESIDENT'S ADDRESS.

Gentlemen of the Northwestern Electrical Association:

It is with the utmost pleasure that I welcome and greet you at this the 12th annual convention of this association, which will, I hope, if such a thing be possible, be of even greater interest to our membership than any which has preceded it. I would, however, expressly disclaim responsibility for such a happy result, but on the contrary place the credit for it where it is due, with our worthy and esteemed secretary.

Having thus unburdened my mind and set myself right on the matter of the programme to be presented for your consideration, I wish now to express my regret for the fact that one of the features which I had hoped to make prominent at this convention will not be among the possibilities at this meeting of our association; I now refer to the "Question Box" and "Wrinkle Department," which I had hoped to make a matter of personal work during the past year, but have been

prevented by the fact that twice within the year 1903 our central station has been destroyed by fire, thus entailing much additional work upon our force and seriously interfering not only with our own service and business, but also with whatever plans I had for the work of the Northwestern Association.

It is not, however, of personal matters that an address of this kind should treat, and I beg your indulgence for their mention.

Again returning to the subject of the programme, I would say that it has been most carefully considered and will cover many matters that will be of extreme interest to our members, both active and associate, and, unless some of our contributors fail us, we shall cover a wide field of information, both theoretical and practical, and I trust that the discussion of the papers presented will be active and searching, as it is in these discussions that the true value of the papers presented is to be found; therefore, do not let your modesty hold you back in these discussions, but add each your mite to the value of these proceedings by bringing forward any point which may suggest itself to you.

It is held by some that the better way to get at the "meat" of a paper is by the prearranged discussion of the papers by those who may perhaps be thought the most competent, but I am of the opinion that where this method is in vogue, the membership generally does not get sufficiently interested to bring forward many points that might suggest themselves, and the "cut and dried" method of discussion gradually undermines the active interest of the members generally and destroys in great measure the usefulness of such associations as ours and interest in the proceedings wanes.

I am further of the opinion that we have within our ranks men and minds, which, if not stifled by an air of prearrangement, are competent enough and bright enough to discuss any paper offered by men who are technical in their respective lines and to bring out many obscure points, and thus make the papers of the more value to all of us; again, therefore, let me urge upon all the necessity of discussion if we are to get full values, and let each contribute his share.

It is unnecessary to add that the commercial side of every proposition is the one which most appeals to the central station man, and it is to be expected, therefore, that those side lights will be thrown on the papers to be read, and it is right and proper that it should be so. It is, of course, from the technical side that the papers are written, and it is from the operative side that they are in measure discussed.

During the year which has but just passed over into history there has been much done which is of interest in our profession, though no startling discoveries or innovations have been brought forward, if possibly we may except the mercury vapor lamp; but still the year has witnessed better development of many appliances, and it is now more than probable that each future year will add to this general betterment, though with less of novel ideas to attract and possibly, as in the past, to discard. The general principles of our business seem to be better settled and more fully grounded and the lines of machine building seem to have reached their limit for a considerable time at least, and therefore the central station man is very much nearer a standard than ever before. This is a hopeful sign for our chosen business and it is probable that our depreciation accounts will be the gainer from the fact that the various apparatus used will not be found, as in the past, to be obsolete almost as soon as installed.

The twin subjects of taxation and municipal ownership are and always will be with us. I am, however, very much of the opinion that both are more likely to be met more in the spirit of fairness than in the past. I have no recommendations in the nature of a cure at all to make upon these important subjects, and can only say that as the nature and hazards of our business are more understood by the general public we will be better treated by the same public through their chosen representatives. Let us at all times treat them with fairness and strive by our good treatment of the public, from whom we receive our franchises, to merit their good will, give them the best possible service for the least possible cost to them and we will make friends instead of enemies, or, at best, doubtful friends, as many seem to think us. The standardization, of which I have spoken, will ultimately be the means of enabling central stations to manufacture their output commodity at a cost which will enable them to supply the public at terms that will, while selling their output at a non-restrictive price, yet realize a fair and equitable profit on their sales, which from the very fact that they are selling standard goods, will increase by the application of their product to many new uses by the consumer.

This then will still further operate to make friends of the general public and thus in a measure silence the popular clamor for high and still higher taxes upon our industry and for the establishment of municipal, lighting and power plants.

I shall not here inflict upon you my personal views as to the rights of the municipal authorities to enter upon a commercial venture in competition with their fellow citizens, but in some occult or obscure way our business seems to be a target, though why other lines, such as provisions, fuel and other public necessities, escape such proposal on their part does not make itself entirely clear to me.

I find that I have already exceeded the limit of time which I had proposed and which is of more value if used for other purposes of this convention, and will therefore again welcome you and thank you for your kind attention and forbearance, and we will now take up the regular business before this assembly.

The address was received with great applause.

The president appointed the following committees: Nominating—R. N. Kimball of Kenosha, H. W. Frund of Vincennes and P. H. Korst, of Janesville. Membership—J. H. Harding of La Porte, W. H. Schott, of Chicago and Irving P. Lord of Waupaca.

Several applications for membership were then presented and referred to the membership committee.

Reports were received from several committees appointed at the last session, all reporting progress—the legislative committees reporting that no legislation had been passed the last year adverse to the association's interests.

The president then called for the paper by Mr. W. H. Schott, of Chicago, on "Central Station Heating." Mr. Schott read his paper and it brought out a long discussion, nearly all the members participating.

The next paper called for by the president was on "Coil Windings for Electrical Purposes," by Messrs. Richard Varley and Charles R. Underhill. The paper was read by the latter gentleman.

Secretary Mercein stated that Mr. Underhill is the chief engineer of the Varley Duplex Magnet Company, and came all the way from Providence, R. I., to read the paper, and on motion a vote of thanks was extended to him by the association.

The paper on "The Electrolytic Rectifier and Interrupter," by Mr. W. Scheidel, was read by the secretary, the author not being present.

The next paper read was by Mr. George C. Keech on "Incandescent Lamps in General—Their Smashing Point in Particular."

A lively discussion followed the reading of this paper, many valuable points being brought out.

An adjournment was then taken until 10 o'clock next day.

THURSDAY—MORNING SESSION.

The convention was called to order at 10 A. M. by the president. He said: "The first item on our programme this morning is questions and answers, but instead we will take up Mr. Waters' paper on "Double Current Generators."

Mr. Waters did not read his paper in full, but said: "I propose to deal with this question of double current generators more from the standpoint of the manufacturer than from that of the central station engineer," and stated that it was the old question of alternating vs. direct current.

The President—We will now listen to a paper on "Rectifiers," by Prof. C. F. Burgess.

The paper was discussed at length and the discussion was concluded by the president saying: "I am firmly of the opinion that some kind of a rectifier is to be the future solution of the automobile problem."

At this point the nominating committee reported the following names for officers and directors for the next year:

President—T. F. Grover, Fond du Lac.

First Vice-President—George H. Lukes, Evanston.

Second Vice-President—F. A. Daniel, Menominee.

Secretary-Treasurer—Thomas R. Mercein, Milwaukee.

Directors—W. H. Schott of Chicago, D. C. Jackson of Madison and H. Almert of Oak Park.

On motion of Mr. Lord the chairman of the committee was directed to cast the ballot of the association for the officers named.

Mr. Grover, the president-elect, was escorted to the chair, and after thanking the members sincerely for the honor conferred upon him retired to allow President Bowen to serve until the end of the meeting.

On motion of Mr. Cutter it was decided to hold the summer meeting in September in St. Louis, to meet with other electrical associations and electrical people, the date to be left to the executive committee.

The convention then adjourned until 1:45 P. M.

THURSDAY—AFTERNOON SESSION.

The convention was called to order by the president and he requested Mr. J. R. Kimball of the Walker Switchboard Company to read the paper prepared by Mr. John J. Gibson on "Standard Practice in the Use of Alternating Current Electrical Apparatus." Mr. Gibson was unable to be present, but the members discussed the paper.

A motion was made and unanimously carried that Secretary Mercein be sent to Boston in May as the association's representative at the annual meeting of the National Electric Light Association.

Mr. J. M. S. Waring then read his paper on "Storage Batteries for Small Central Stations," which he illustrated with lantern slides, and this was followed by a paper on "Steam Turbines," by Mr. James Lyman.

At the conclusion of Mr. Lyman's paper Prof. R. A. Milliken delivered a very interesting lecture on radium.

The lecturer was loudly applauded when he concluded and the convention adjourned until the following morning.

FRIDAY'S SESSION.

The convention was called to order by the president at 10 A.M., but there being no business to transact the president declared the convention adjourned sine die.

New York Electrical Society.

The 240th meeting of the Society will be held at the American Institute, 19 West 44th street, this (Wedensday) evening, January 27, at 8 o'clock.

Prof. W. E. Goldsborough, chief of the Department of Electricity, World's Fair, St. Louis, will lecture on "The Influence of Electricity upon Expositions."

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JANUARY 19, 1904.

Electric Railways and Appliances.

749,716. Rail-Contact-Shoe, George W. Brady and Lawrence R. Jones, Wheaton, Ill. Filed Jan. 26, 1903.

749,795. Trolley-Stand. James Kermath, Detroit, Mich., assignor, by direct and mesne assignments, to the Eclipse Manufacturing Company. Filed Oct. 9, 1903.

749,916. Trolley for Overhead-Electrical Conductor Systems. Eugenio Cantono, Rome, Italy. Filed Aug. 3, 1903.

749,939. Railway Signaling Apparatus. John F. Mickey, Frank T. Bailey and Joseph J. Noppenberger, Baltimore, Md. Filed Aug. 1, 1903.

750,117. Electrical Operated and Controlled Railway Signal. Robert D. Peters, Knox, Ind. Filed Nov. 21, 1902.

750,139. Electrical Controller for Railway-Cars. Harlan P. Wellman, Ashland, Ky. Filed Nov. 19, 1903.

Electric Lights and Appliances.

749,998. Electric Tube-Lamp. Daniel M. Moore, Newark, N. J. Filed Jan. 22, 1903.

749,999. Electrode for Electric Tube-Lamps. Daniel M. Moore, Newark, N. J. Filed Feb, 26, 1903.

750,198. Socket for Incandescent Lamps. Owen E. Kenney, Toledo, O., assignor to the Yost-Miller Company. Filed June 16, 1902.

Electrical Machinery and Apparatus.

749,835. Electrochemical Switching Mechanism. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed May 29, 1903.

749,841. Portable Electrically-Driven Drilling Apparatus. George F. Campbell and Stanley T. Isherwood, Bootle, Eng. Filed Nov. 26, 1901.

749,949. Indicating-Dial for Snap Electric Switches. Charles G. Perkins, Hartford, Conn. Filed Oct. 29, 1903.

750,009. Electromagnetic Gearing. Eric Thordon, Pittsburg, Pa., assignor to the Westinghouse Machine Company. Filed Feb. 6. 1903.

750,012-750,013. Fire-Alarm Mechanism. Leonidas G. Woolley, Kenton, O., assignor to Asa C. Cooney, same place. Original application filed April 27, 1903. Divided and this application filed July 6, 1903.

750,039. Ruhmkorff Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed Aug. 21, 1903.

750,040-750,041. Vibratory Circuit-Controller. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed Oct. 19, 1903.

750,068. Electrically-Operated Railway Gate. Max Spinrad and Hans Buechting, New York City. Filed June 16, 1903.

750,115. Automatic Electric Pump. Francis L. Orr, Thurman, Ia., assignor of one-half to William W. Keyser, Percival, Ia. Filed Sept. 9, 1903.

750,207. Electromagnetic Brake. John S. Lockwood, Kansas City, Mo. Filed June 23, 1902.

750,239. Electrically-Heated Soldering-Iron. William J. Bowen, Cleveland, O., assignor to the Williams-Abbott Electric Company, same place. Filed Aug. 17, 1903.

750,244. Fuse for Electric Circuits. Elwood C. Phillips, Chicago, Ill. Filed Jan. 9, 1903.

Telephones and Telephone Apparatus

749,798. Central-Energy Telephone System. Kempster B. Miller, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Dec. 19, 1900.

749,814. Relay Device. John P. Downs, Cleveland, O assignor to the North Electric Company. Filed May 7, 1902.

749,824. Telephone-Exchange. Nils E. Norstrom, Chicago, Ill., assignor of two-thirds to John Anderson Salina, Kan., and M. E. Richardson, Sterling, Kan Filed Nov. 23, 1900.

749,977. Telephone-Hook Switch. Ernest E. Yaxley, Chicago, Ill., assignor to the American Electric Telephone Company. Filed June 12, 1901. Renewed Dec. 23, 1903.

749,982. Electrical Signaling System. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company. Filed Dec. 19, 1901.

Miscellaneous.

749,769. Electric Sanitary Closet. James H. Wilson, Lowell, Mass. Filed Oct. 23, 1902.

749,775. Electrostatic Relay, Dan La Cour, Copenhagen, Denmark. Filed Feb. 7, 1903.

749,785. Battery-Plate. Oskar Frank, Detroit, Mich., assignor to Levi J. Lennox and the Michigan Storage Battery Company, same place. Filed May 2, 1903.

749,791-749,792. Means and Method for Reproducing Electrical Variations. Peter C. Hewitt, New York City, assignor, by mesne assignmets to the Cooper-Hewitt Electric Company. Filed May 16, 1902.

749,793. Regulator for Gas or Vapor Electric Apparatus. Peter C. Hewitt, New York City, assignor, by mesne assignments, to the Cooper-Hewitt Electric Company. Filed May 16, 1902.

749,813. Portable X-Ray Apparatus. Eugene W. Caldwell, New York City. Filed Jan. 16, 1903.

749,854. Means for Converting Faint Vibrations Into Electrical Energy. William H. Fahrney, Chicago, Ill. Filed Jan 10, 1903.

749,855. Process of Producing Electrodes for Storage Batteries and Electrode. Frederick A. Feldkamp, Newark, N. J., assignor to the Electra Manufacturing Company. Filed May 19, 1903.

749,867. Method of Securing Electric Wires. Alexander Kline, Jersey City, N. J. Filed March 31. 1902.

749,868. Power Transmission Device. John F. Krema, Chicago, Ill. Filed July 23, 1903.

750,093. Electric Resistance Furnace. Alfred H. Cowles. Cleveland, O. Original application filed Nov. 20, 1902. Divided, and this application filed April 21, 1903.

750,095. Process of Electrically Heating Materials. Alfred H. Cowles, Cleveland, O. Filed Nov. 5, 1902.

750,102. Electric Automobile. Thomas A. Edison, Orange, N. J. Filed Jan. 9, 1903.

750,132. Electromagnet. Illius A. Timmis and Edgar W. Timmis, London, Eng. Filed June 19, 1903.

750,150. Electric Fire Alarm. Joseph A. Barten and Samuel R. Sneeringer, Philadelphia, Pa. Filed April 30, 1903.

750,170. Method of Electric Heating. Alfred H. Cowles, Cleveland, O. Filed Nov. 5, 1902.

750,171. Electric Furnace. Alfred H. Cowles, Cleveland, O. Filed Nov. 20, 1902.

750,179. Electric Blanket. Charles Foglesong, St. Paul, Minn. Filed Sept. 14, 1903.

750,180. Method of Controlling Spark Production. Lee De Forest, New York City. Filed June 17, 1903.

THE TELEPHONE WORLD.

Coming Meeting of Ohio and Indiana Telephone Association.

Arrangements have been made for the annual meeting of the Ohio and Indiana Telephone Association, which will be held at the Grand Hotel, Cincinnati, on February 17, 18 and 19. Two hundred delegates will be in attendance, and many important matters pertaining to the Independent telephone business will be discussed. A number of prominent telephone men from various sections of the United States will be in attendance and will address the convention.

It has been stated that a telephone company has been organized at Front Royal, Va., and will construct lines throughout Rappahannock County, and connect with those in Page and the adjacent counties in the upper part of Virginia Valley. It is expected that eventually 'phone communication will be had with Washington, D. C., and other points. The projectors of the new line are Messrs. C. W. Trevary, G. W. Forsythe, S. G. Allen and Oder Harrell.

The Collinwood Rural Telephone Exchange Company was organized in Dassel, Minn., a short time ago, with Simon Aster as president, A. J. Broberg, vice-president, and John Enquist, secretary. The company will build about 15 miles of telephone line in the rural districts.

The Gainesboro Telephone Company, of Carrollton, Ga., recently came into control of the lines of the Commercial Telephone Company of Atlanta. The two systems will be united. With this purchase the Gainesboro Company owns about 400 miles of wire and has 10 city exchanges and 60 stations. It is in a very prosperous condition and will largely increase its system.

A new telephone company, with a capital stock of $25,000, and called the Neighbor State Telephone Company, was lately incorporated at St. Paul., Minn. The incorporators are P. M. Andersgood, Sam Gilbertson, H. H. Harvey, Lars Berhardson and Gilbert N. Roen.

The Willow Creek Telephone Company has completed its new line from Madelia to Vernon Center, Minn. The latter place has connections with all the surrounding villages and farming communities, besides a direct line to Mankato and the long-distance 'phone.

At the annual meeting of the Co-operative Telephone Company of Detroit, Mich., C. M. Burton, Max J. L. Towler, J. C. Danzinger, J. W. Howland and A. A. Cowles were elected directors.

A new telephone line, to connect Dundee, Rock Stream, Reading Center and Watkins, N. Y., is being subscribed for along the line. H. J. Hunt, of Reading Center, has the matter in charge.

William Knottes, who owns the telephone system now in use at Long Pine, Neb., has decided to install the Clark automatic exchange system.

The Vermilion County, Ill., Telephone Company has increased its capital from $150,000 to $400,000.

Independent Telephone Competition.

The Fall River, Mass., Automatic Telephone Company is paying its fourth regular quarterly dividend of 1¼ per cent.

The company on December 31, 1903, had 1,160 stations, an increase of 100 for the quarter.

A director says: "The company continues its regular dividend payment in the face of the fact that its toll between Fall River and New Bedford is 15 cents, while the New England Telephone & Telegraph Company has reduced its toll between these two cities from 15 to 5 cents."

For several years past G. T. Conine, a business man, of Prattsburg, N. Y., has been putting up telephone lines from there to various surrounding towns. The enterprise has been gradually extended until there have been erected 150 miles of line, extending to various points in Steuben, Yates and Ontario Counties. In order to more thoroughly and systematically supervise and prosecute the growing business, a stock company has been organized and incorporated with a capital of $10,000. Dr. B. J. Scott is president of the company and R. T. Conine, secretary and general manager. The name under which it is incorporated is the Prattsburg Overland Telephone Company. Already active preparations are being made to double the present territory, which will thus give subscribers a more extended and satisfactory service. Lines will soon be put up connecting Hammondsport, Bath, Avoca, Cohocton, Atlanta, Wayland and many smaller place, with a central office and switchboard at convenient points. The company now has scores of subscribers among farmers and others between the various villages reached by its lines.

The new barbed wire telephone system radiating from Chester, east of Spokane, Wash., has been opened. The new telephone system is independent of the Pacific States Telephone Company, but connects with it at Chester. The farmers have an exchange of their own at Chester, from which the lines to different farmers radiate. There are already 11 subscribers, with 16 miles of line in operation, the longest of which is eight miles.

For some months past the matter of placing a portion of the wires of the Mexican Telephone Company in the city of Mexico has been under discussion. The plans are now pretty well completed and within a short time active work of laying conduits will begin. It is not known yet what arrangements for financing these improvements will be made, although it is the understanding that the Government will foot a portion of the bills. The net result will be to benefit the company through increasing the number of subscribers, and possibly by increasing the rate of tariff.

Contracts were recently made by the board of public safety of Indianapolis, Ind., for telephone service for the police department. The new company will furnish 74 telephones and a new switchboard at the headquarters for $1,250, and the old company will give 84 instruments for $1,248.

New Police 'Phone System.

The police street telephone system, which has been in course of construction in this city for several months, has now been practically completed in five downtown precincts and is in working order. The station houses where the system is now being used are Old Slip, Oak street, Church street, Elizabeth street and Leonard street. Work on the system will be continued until every precinct in Manhattan is similarly equipped.

The system consists of street boxes placed at convenient points throughout each precinct connected with the station house by extra wires put up by the telephone company. Each box is so contrived that when it is unlocked and the door opened the receiver is lifted automatically and connection is established at once with the station house, causing a disk to fall on the switchboard at the sergeant's desk, indicating the number of the box that is calling. The box can be opened and closed after communication with the station house in one minute.

The farmers who live at East Penfield, a hamlet 2½ miles northeast of Fairport, N. Y., held a recent meeting and organized a telephone company to operate in the town of Penfield. They elected their officers and signed incorporation papers. They also signed an agreement with the Interocean Telephone Company, to connect their lines with the Fairport exchange. All their circuits connect directly with Fairport. There will be free exchange between the two companies. Other rural companies are organizing and it looks as though the whole country around Fairport would soon be connected by telephone.

The articles of incorporation of the Hudson, Ia., Mutual Telephone Company were filed with the county recorder a short time ago. The company has no capital stock, doing business on the mutual plan wholly. The officers of the company are: President, H. B. Eighmey; vice-president, William Crownover; secretary and treasurer, W. J. Glenn.

At the annual meeting of the Utica, N. Y., Home Telephone Company the following officers were elected: President, Edgar B. Odell; vice-president, H. F. Miller; treasurer, Edward Bushinger; secretary and manager, C. H. Poole.

At the meeting of the stockholders of the Chicago Telephone Company last week the authorized capital stock was increased to $20,000,000 from $15,000,000. The new $5,000,000 will be spread over possibly three years. In 1899 the company's capital was $5,000,000.

The Livingston County Mutual Telephone Company, of Howell, Mich., has elected the following officers: Frank Backus, president; H. E. Reed, secretary; A. J. Van Patten, treasurer.

A new telephone company has been organized in Daleville, Ind., capitalized at $10,000. The construction will begin immediately. About 20 miles of new pole lines will be built.

The Brunswick Independent Telephone Company, of Medina County, O., has recently been incorporated.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aurora, Ind.—The city council has refused to renew the electric light contract and the city is in darkness. Plans are under way to install an electric light plant to be owned by the city.

Austin, Tex.—The city water and light commission contemplates increasing the equipment of the light and power plant by the purchase of a turbine engine. The proposed improvements will cost about $20,000.

Baltimore, Md.—New York lighting interests, headed by Anthony N. Brady, were last week given representation in the directory of the United Electric Light & Power Company. This is the company back of the scheme for utilizing the rapids of the Susquehanna River in the vicinity of Conewango for electrical development.

Bancroft, Mich.—The citizens are agitating the question of installing a system of waterworks and an electric light plant.

Boyd, Wis.—The Cirkel Manufacturing Company will install a new electric light plant in this city.

Bromley, Ky.—The citizens here are agitating the question of establishing a system of electric lights and waterworks.

Buffalo. N. Y.—At a recent meeting of the South Park District Taxpayers' Association, a resolution asking the aldermen to substitute electricity for gas now in use in that section was adopted.

Chatham, N. Y.—The Boston & Albany Railroad Company is considering the advisability of installing a private electric light plant in the union station here.

Clinton, Ill.—E. F. Clark is asking a 20-year franchise from Kenney to operate an electric light plant.

Conyers, Ga.—M. L. Wood and W. U. Wallace, aldermen of this city, are investigating the matter of installing an electric light plant here.

Duquoin, Ill.—J. Ward Blakeslee and Ray S. Linzee are desirous of operating the electric light and power plant here and will ask the city council for a franchise to use the streets and alleys. They will also construct a street railway.

East St. Louis, Ill.—A petition has been presented to the council for additional arc lights at various corners of the town.

Eldorado, Ark.—The Eldorado Industrial Company has been formed to produce and distribute electricity for light, heat and power. The capital stock is $80,000.

Fairfax, Vt.—The Vermont Power & Manufacturing Company will install a new electric light plant here.

Ft. Wayne, Ind.—Messrs. Schnitker and Clark, trustees of the town of New Haven, are working for an electric lighting plant for their corporation both for street and commercial lighting.

Gallup, N. M.—The Gallup Electric Light Company has been incorporated with a capital of $50,000, by M. Gunsel and Herbert F. Raynalds, of Albuquerque and Kenneth K. Scott, of this city.

Grove City, Pa.—Applications have been made to the borough council for a franchise for an electric light and power plant.

Heflin, Ala.—The city council has granted to F. F. Taylor and W. B. Merrill a franchise to construct and maintain systems of waterworks and electric lights in this town for a period of 30 years.

Nazareth, Ky.—This town is preparing to install an electric light plant.

New Castle, Pa.—Dr. E. J. Fithian and John Carruthers have applied for a franchise for an electric light and power plant.

Perham, Minn.—The waterworks pumping station and electric light power house were damaged by a recent fire.

Portage, Wis.—It is stated that the Chicago, Milwaukee & St. Paul Road will put in an electric light plant and pumping station of its own in this city

Rapid River, Mich.—The installation of an electric lighting plant is talked of by the business men here.

Shell Lake, Wis.—It was lately voted to borrow $10,000 from the State to establish and equip an electric light plant.

Shelton, Wash.—The local electric light plant has been purchased by W. H. Kneeland, who will enlarge the same.

Teneriffe, Canary Islands.—The electric light company here is desirous of purchasing an American electric light engine of at least 500 hp. Address Senor Don Nicolas Marti, presidente Compania Electricia Industrail, Teneriffe, Canary Islands.

Tybee, Ga.—The Savannah Electric Company is considering the matter of furnishing electric lights here.

Wilmette, Ill.—The North Shore Electric Light Company has secured a franchise from the town board and will install electric lights in this village.

Williamsburg, O.—Charles Hoffman, village clerk, will receive bids for a $12,000 electric light plant.

STREET RAILWAYS.

Ada, Mich.—A committee of the leading business men of this place has been appointed to discuss the route of the proposed Grand Rapids & Ionia Electric Railway. It is believed that the village offers advantages to the road which can readily be shown.

Albuquerque, N. M.—The final step in the transfer of the Albuquerque Street Railway Company to the Albuquerque Traction Company has taken place, which eventually means the old horse car line will be changed to electric. Engineers are completing their plans and surveys for the company.

Charleroi, Pa.—The promoters of the Allenport & Roscoe Electric Railway are making preparations to begin work on the construction of their line in the spring.

Charlottesville, Va.—The Virginia Railroad & Improvement Company will run a trolley from here to Point of Rocks, Md.

Crookston, Minn.—An electric line for the northern portion of this State, connecting Grand Forks, Fargo and Moorhead with this city and Maple Lake, has been proposed here. J. P. Booher is interested in the enterprise.

Galveston, Tex.—Conversion of the Gulf & Interstate Railroad into an electric line, and the consolidation of two other electric lines, all under one control, is reported to have been practically accomplished by John W. Gates and his associates.

Greenville, Ill.—The Southern Electric Company will build several new lines in this vicinity.

Lansing, Mich.—Manager Elliott, of the Lansing, St. Johns & St. Louis Interurban Railway Company, states that he expects to have the road fully equipped with electricity by February 15.

Lynden, Wash.—The immediate construction of an electric line of railways from Bellingham to this city, 16 miles distant, was lately assured, by the filing of a mortgage by the Lynden Electric Company, which was incorporated for this purpose to the Corporation Trust Company of New York for $160,000. C. T. Likins, of Bellingham, is president of the new company; C. A. Wyatt and G. A. Butters constitute the board of directors.

Newburgh, N. Y.—Permission has been granted by the State Railway Commission to the Intervale Traction Company of New York and Newburgh to build a trolley line between this city and Goshen. This line will be about 25 miles in length and will link the Orange County Traction Company and the Newburgh & Middletown Railway Company. The entire system when completed will include about 55 miles of track.

Savannah, Mo.—C. E. Bartlett, D. Eversole and Judge Thompson, directors of the Maryville & St. Joseph Electric Railway, recently met the citizens of Savannah and farmers of the county in a right-of-way meeting. Those present promised assistance in securing right-of-way. The directors announced that they had secured about 12 miles of right-of-way in this county for the line.

Washington, D. C.—The Washington & Marlboro Electric Railway Company may build a line here.

Woodland, Cal.—N. A. Hawkins has been granted a franchise to operate electric railways here for a period of 50 years.

POWER PLANTS.

Boise, Idaho —Neo Bunch is the promoter of a project to put in an electric plant to supply the mines of the surrounding country with power.

Idaho Falls, Idaho.—The Idaho Power & Transportation Company, of which George Chapin is president, will install a 3,000 hp. plant on the Snake River. A dam will be built.

Pasco, Wash.—Considerable interest is being aroused here in the matter of utilizing the falls in the Snake River, either at Fishhook Rapids or Five Mile Rapids, to generate power for irrigation and lighting.

Vera Cruz, Mex.—Filberto Romero, of this city, has been granted a concession by the Mexican Government for the construction of a hydraulic power plant on the river Tanocco at a place called Chorro Grande, in the State of Vera Cruz. The plant will be utilized for the purpose of generating energy for electric lighting and power purposes in the vicinity.

Worcester, Mass.—Theodore C. Bates, 29 Harvard street, wants data regarding the practicability of a long distance electric power transmission.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12⅝c.; Lake 12⅝@12¾c.; casting, 12⅜@12½c.

The Hudson River Telephone Company has declared the customary 1½ per cent. quarterly dividend.

The annual meeting of the stockholders of the Brooklyn Rapid Transit Company will be held on January 29.

The American Telephone & Telegraph Company owns $6,-760,000 of the capital stock of the Chicago Telephone Company.

A foreclosure decree has been entered against the Lehigh Power Company of Easton, Pa., on its mortgage bonds amounting to $325,491. A sale has been ordered.

Supreme Court Justice Kellogg has granted an order appointing Walter P. Butler as referee to sell the Ballston (N.Y.) Terminal Railroad, a local electric line, on March 8.

The disputes arising out of the different interpretations of the leases existing between the Chicago Union Traction Company and its underlying companies are to be investigated by a Master in Chancery.

George R. Beach of Jersey City, receiver for the Storey Motor and Electric Company of Harrison, N. J., announced Saturday last that he was ready to pay to his creditors a first dividend of 25 per cent.

The Brooklyn Rapid Transit Company is said to be negotiating with bankers to float between $5,000,000 and $6,000,000 of bonds. The proceeds will be used to liquidate a debt of about $1,500,000 and to pay for a new power plant.

A director of the Electric Storage Battery Company says: "The company has all the work it can do. There is nothing to prevent our paying dividends as in the past. The Edison battery has not yet proved itself a factor in the market."

The best grades of lake and electrolytic copper are obtainable in New York at 12⅝ cents per pound, as against 13 cents ten days ago. The offering price was reduced ¼ cent on Saturday. The unexpected falling off in the demand from abroad was the cause of the reduction.

Gross earnings of the Toledo (O.) Railways and Light Company for the year were $1,655,000, a gain of $195,909. Estimating the net earnings at $793,000, and fixed charges, interest and rentals at $495,000, there is left available for dividends $298,000. This would be equivalent to about 2⅜ per cent. on the stock.

On April 1 the Manhattan Elevated Railroad Company of New York will turn over to the Interborough Company $1,500,000, its year's net earnings above the 7 per cent. guarantee of the Interborough Company. Present earnings of the Manhattan Company are said to be $5,000 per day ahead of last year.

The annual report of the General Electric Company, for the fiscal year ending January 31, will be submitted early in February. Preliminary information from a director is to the effect that the earnings (January partly estimated) will approximate $7,000,000 in excess of all expenses, fixed charges and dividends. The cash surplus will total about $4,000,000.

There will be a meeting of the stockholders of the People's Rapid Transit Company of Cincinnati on February 12, at which time the present charter will be given up and a new company will be organized under the name of the Cincinnati, Toledo & Detroit Short Line Railway Company, with a capital stock of $6,000,000. The capitalization of the present company is $500,000.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Jan. 25
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	144½
Metropolitan Street Railway	122½
Metropolitan Securities	90
Ninth Avenue	200
Third Avenue	120½
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	49½
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	269
Philadelphia.	
Consolidated Traction of New Jersey	65⅜
Philadelphia Traction	97⅝
Union Traction, $17.50 paid	48
Boston.	
Boston Elevated, full paid	140
West End Street, com	90
do. do. do. pref	110
Chicago.	
City Railway	165
North Chicago	87
Union Traction, com	6⅝
do. do. pref	32½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	20
do. do. pref	50
Electric Lead Reduction	⅞
Electric Vehicle, com	11
do. do. pref	15
Westinghouse, com	171
do. pref	192
General Electric	177
Boston.	
Edison Electric Illuminating	237
General Electric	177
Massachusetts Electric Companies, com	23½
do. do. do. pref	80
Westinghouse Electric & Mfg., com	83½
do. do. do. pref	92
Chicago.	
Chicago Edison	150
National Carbon, com	28
do. do. pref	95
Philadelphia.	
Electric Company of America	8¼
Electric Storage Battery, com	60
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	128¾
Western Telephone Company	11
New England Telephone Company	122
New York.	
American Telegraph & Cable Company	86¼
Commercial Cable Company	190
Mexican Telephone Company	2
New York & New Jersey Telephone Company	140
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88½
Miscellaneous.	
Chicago Telephone Company	90
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	26½
Consolidated Car Heating	66
Standard Underground Cable	200

ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

London's New Tube Railway.

On another page of this issue we are able to give particulars of the new electric railway which, after many delays, has at last been completed for traffic between the heart of the city of London and one of its most populous suburbs, Finsbury Park, some three to four miles to the north. The opening of this line comes at a moment when the three tube lines already working have not recovered from the effect of the Paris Metropolitan Railway disaster. During the past six months or so, we are informed, the passengers carried by these lines have been reduced in number to an almost alarming extent, and a falling off in receipts at the rate of over $2,500 per week in two cases cannot fail to affect the dividend declarations which are made during the next few weeks.

The Great Northern & City engineers and directors are able to commence operations with an undertaking which is in a position to take advantage of the mistakes and troubles which have arisen in connection with earlier lines. It is but natural, therefore, that every precaution for the safety of the public should have been taken. The experience of this latest system should prove interesting.

* * *

Aluminum Coming Into Favor.

A five-line item in the Boston *News Bureau* a few days ago, stating that the Edison Electric Illuminating Company had purchased a total of 300,000 pounds of aluminum for its transmission lines, connecting its various suburban companies with its new $4,000,000 Boston power house, or sufficient to equip 250 miles of transmission line, has aroused considerable interest as to the extent that aluminum is taking the place of copper in electrical transmission.

The Edison people took exception to the statement on the ground that it would appear to show that that company had abandoned copper for aluminum, while as a matter of fact their purchases of copper have been far greater than of aluminum.

The facts in the case are that the Edison Company has purchased, to be exact, a total of 298,245 pounds of aluminum wire, which represent a total of 246 miles, sufficient to equip 82 miles of transmission line, a high tension transmission system requiring three sets of wire. This fact shows that aluminum is coming into favor.

Aluminum is in quite extensive use in New England for electrical transmission. The Massachusetts Electric Companies has purchased about 500,000 pounds as a substitute for copper wire and it is giving complete satisfaction, being much lighter on the poles than copper and easier to handle. The Boston & Maine Railroad, the Tucker, Anthony & Co. properties, Hartford Electric Light Company and the new Milford (Conn.) Power Company have all placed large orders for aluminum wire as a substitute for copper.

The Lewiston & Auburn (Me.) Electric Light Company which has equipped its lines with aluminum, writes the following letter:

"Last year we put out about 20 miles of aluminum wire equipment and I think we shall use it in the future for all our trunk lines. We like it on account of its weight, also because we believe the chances of breakage are much less with aluminum that with copper and we also find that it does not load up with snow and ice as our copper feeders do."

One transmission line of the Niagara Falls Power Company, from Niagara Falls to Buffalo, 26 miles, is aluminum, over which is transmitted current at a voltage equivalent to as high as 17,000 hp., and

since its installation a few years ago it has not shown the slightest deterioration from atmospheric conditions.

* * *

The More Economical Production of Electricity.

Those who are responsible for the business side of a public electric light and power plant are constantly having brought before them the very practical question, "At what price can you supply power to factories and workshops, in competition with isolated steam power plants?" There is plenty of evidence at our disposal to show that each is superior to the other, and this evidence receives its coloring from the particular experience or leanings of the engineer or official who produces it. Local considerations, and especially the contiguity or otherwise of the factory to be driven, to the source of fuel, affect the result very largely. The position of the whole question of electric driving has been changing considerably during the last few years. It is not now so necessary as it was to enter into elaborate arguments to convince the works proprietor or his manager of the advantages which are sure to follow the abandonment of antiquated steam driving. The day for this may perhaps be said to have gone by, at any rate that is so for the generality of cases. The eloquent object lessons open to the eyes of manufacturers on every hand do for the electrical engineer this educational part of the work, which, in England at least, proved to be one of the hardest problems of all not so very long since. The present position of the matter, then, is not to convince the inquirer that he can save so much per cent. of his working expenses, but to help him to decide which course is likely to be the more profitable for him to adopt, whether he shall put down his own generating plant, or take supply from the public mains.

In the Lancashire weaving and spinning mills districts fuel is within comparatively easy reach of the numerous manufacturing towns, and it may be said that in order to study the question of fuel economy, no better example could be taken than the coal consumption at these works. They can produce an indicated horse power hour for about 2 pounds of good coal, and at $1.75 per ton they show an ideal figure of .25 cent per unit for coal consumption. The conditions which obtain in mills of this class conduce to a very high load factor—practically 33 per cent.—and the losses from condensation in steam pipes are a minimum, whilst the power taken by the auxiliary machinery, feed pumps, etc., is a very small percentage of the output, notwithstanding that there is a poor vacuum at certain times of the year, comparatively low pressure, and the mills work without any superheat, except in isolated instances. The load factor is therefore responsible entirely for the fuel economy. If they had the same load factor many generating stations could obtain the same fuel economy, and those which are suitably situated for coal and water could show still better results; but the fact remains that no English generating station has such a load factor, and Mr. A. S. Giles, who is responsible for the operation of the Blackburn lighting and traction power station, suggested at a meeting of the Manchester Institution of Electrical Engineers on January 19 that electricity works' engineers should study their generating costs most carefully item by item. The coal bill represents some 50 per cent. of the total works' costs and is therefore the most important factor of all. There is no portion of a steam plant perfect indeed, each is the seat of losses, more or less serious. The points taken by Mr. Giles in the course of his recital of these losses were: The engineer must make his own tests of the calorific value and cleanliness of the fuel that he adopts before he places his contracts; for large stations mechanical stokers are found to be most satisfactory and to lead to big economies, but for small stations burning, say 50 tons per week, they show but little gain over hand firing unless it is necessary to avoid all smoke, or to burn a very small low class fuel.

The conditions of combustion, the admission of air, and the analysis of flue gases are not studied sufficiently in central station practice. The cleanliness of the surfaces of the metal between the furnace gases and the water, affects the efficiency from 10 to 15 per cent. or even more; to get the maximum efficiency from the fuel there must be the least possible loss of heat in transmission from the fuel to the water. The loss of heat by radiation is a serious item, and engineers are concerning themselves more and more with the use of the most effective composition for covering boilers, pipes, etc. The economic advantages of superheat with regard to coal consumption are most marked, and Mr. Giles gave tabulated data showing what could be gained in this direction when compared with the use of saturated steam. Some central stations do not obtain a good vacuum at the engines, and separate condensing plants are to blame for some of the poor results on record. The tables prepared by the author fully proved that an enormous loss of heat takes place in central stations in converting the heat from the coal to electric energy. Increasing the load factor and reducing the coal bill were the chief directions in which the engineer could look for help toward supplying power at cheaper rates in order to compete with the isolated plant.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Secretary Davis informs us that at a meeting of the executive committee of the National Electric Light Association, held at the Waldorf in this city January 25, the dates for the next convention, to be held in Boston, were decided upon, namely, May 24, 25 and 26.

President Mellen of the New Haven Railroad has issued orders to equip a vestibuled train with an electric lighting plant, with generators on the car axles. It is his intention to replace gas with electricity all over the line.

A cable dispatch from Paris says the *Matin* and other leading papers are loud in demanding that radium remain a specific French article, which all the world shall buy in France. "Radium," says the papers, "is a French discovery, and we would be foolish to allow other nations to profit by the genius of our scientific men." At the same time Austria is being savagely attacked "for keeping up the price of the raw material"—in order to protect her Bohemian glass industry. The only place outside of Austria where pitchblende, the raw material for radium, is obtainable at present is in Buffalo, N. Y.

Richard T. Laffin, who will be general manager of the big American street railway system to be inaugurated in Manila, states that his company will invest $4,000,000 in organizing a street car service of 40 miles.

The question of the exportation of electricity from Canada to the United States has reached a point where it must be decided one way or the other. A deputation headed by Mr. W. Caryl Ely, of the International Railway Company of Niagara Falls, N. Y., last week interviewed Premier Ross on the situation. Mr. Ely has made application for permission to bring electric power from his company's power house on the Canadian side of the river to operate its cars at Niagara Falls. The Ontario Government doubts its right to permit such exportation but will give the matter due consideration.

ELECTRIC TRAINS ON THE NORTH-EASTERN RAILWAY IN ENGLAND.

BY FRANK C. PERKINS.

The electrification of the North-Eastern Railway in England has created a great deal of interest, not only in Europe but also in America, for it is well known that the same problem will have to be faced by managers of every railway operating near large cities and having a considerable amount of suburban traffic. The only method of competing with the numerous trolley lines for suburban traffic is to change the method of operation from steam to electric power. This is the only means by which the present steam railways can increase or even maintain the profits derived for suburban traffic.

The accompanying illustration, Fig. 1, shows one of the new trains on the North-Eastern Railway operated upon the direct current third-rail system from the city of Newcastle-on-Tyne through the various towns and cities in that neighborhood and along the River Tyne, both banks of which are densely populated, and built up with many engineering works and ship building yards. The North-Eastern Railway also has an extensive holiday resort passenger traffic, as on the north of the mouth of the River Tyne lie Tynemouth and Whitley Bay, which are also favorite residential districts. In addition to the electrical trains for passenger service of the character shown in Fig. 1, electric locomotives are employed in the Quayside Branch Line, which is used for freight traffic only. The object of operating this line electrically, carrying as it does only freight, was to overcome the ventilation difficulties which now prevent the line from being fully utilized owing to its being on a very heavy gradient and almost entirely in tunnel. The current for operating the electric trains is at present obtained from the Neptune Bank Station at Wallsend, owned by the Newcastle-on-Tyne Electric Supply Company, Ltd., but as this station is now running at nearly its full capacity, in the near future power will be taken from the new Carville steam turbine station now under construction about 1,000 yards further down the river. The new Carville power station now building will be equipped with a number of steam turbo-generators of 5,000 kw. maximum capacity. The turbines are being constructed by C. A. Parsons & Co., and are to be supplied with steam at 200 lbs. pressure, superheated by 150 degrees Fah. The condensers are installed underneath the steam turbines so as to secure the highest vacuum. On account of the small space required for the steam turbines as compared to high power reciprocating engines, it was not considered necessary to place the boiler house parallel with the engine room and instead a separate range of boilers running at right angles to the engine room is provided for each turbine, one centrally fired boiler house is really arranged for every two ranges of boilers, the same being provided with condensers, induced draught fans, independent flues and a short iron chimney. The boiler equipment is of the Babcock & Wilcox type and the above-mentioned arrangement provides a very short and simple steam pipe system, which it is possible to increase in capacity at any time without affecting the general plan of the station, or interfering in any way with that part of the plant already in operation, as the station can be easily extended in any direction.

The steam turbines are directly coupled to alternators of the rotating field type with direct connected exciters. The three-phase alternating current produced by the 5,000 kw. generators has a frequency of 40 cycles per second and a pressure of 5,000 volts. This current is conducted over three-phase high tension cables supplied by Siemens Bros. & Co. to five substations located at Benton, Kenton, Wallsend, Pandon Dane and Cullercoats. The current is reduced in pressure at the substations by static transformers of the Westinghouse single-phase, oil-insulated, self-cooling type and changed to a direct current of 600 volts pressure by 800 kw. rotary converters installed in the various sub-stations. There are fourteen of these rotary converters in all having a total capacity of about 12,000 kw., one of the largest sub-stations, that at Pandon Dane, having four rotary converters of a capacity of 3,200 kw. In order to take care of very heavy loads these rotaries were constructed to stand an overload of 200 per cent. for a short length of time and an overload of 100 per cent. for nearly a quarter of an hour without injury. The trains on the North-Eastern Railway operated by electric power consist of three cars, a trailer being placed between two motor cars. The motor cars are arranged with operators' compartments at one end only, although a master controller is arranged at the other end as well as in the trailer cars so that the trains may be controlled from any point where there is likely to be need of such control. It is impossible to leave a master controller in a wrong position or to work two of them at the same time on account of the interlocking handles which are provided. The multiple unit system was considered the best for this purpose as all of the electrical lines enter the terminal central station at Newcastle and the trains have to be taken in by one locomotive and out over the same lines by another, causing great difficulty in working the suburban traffic. The electrification of these lines and the adoption of the multiple unit system was considered a correct solution of the problem.

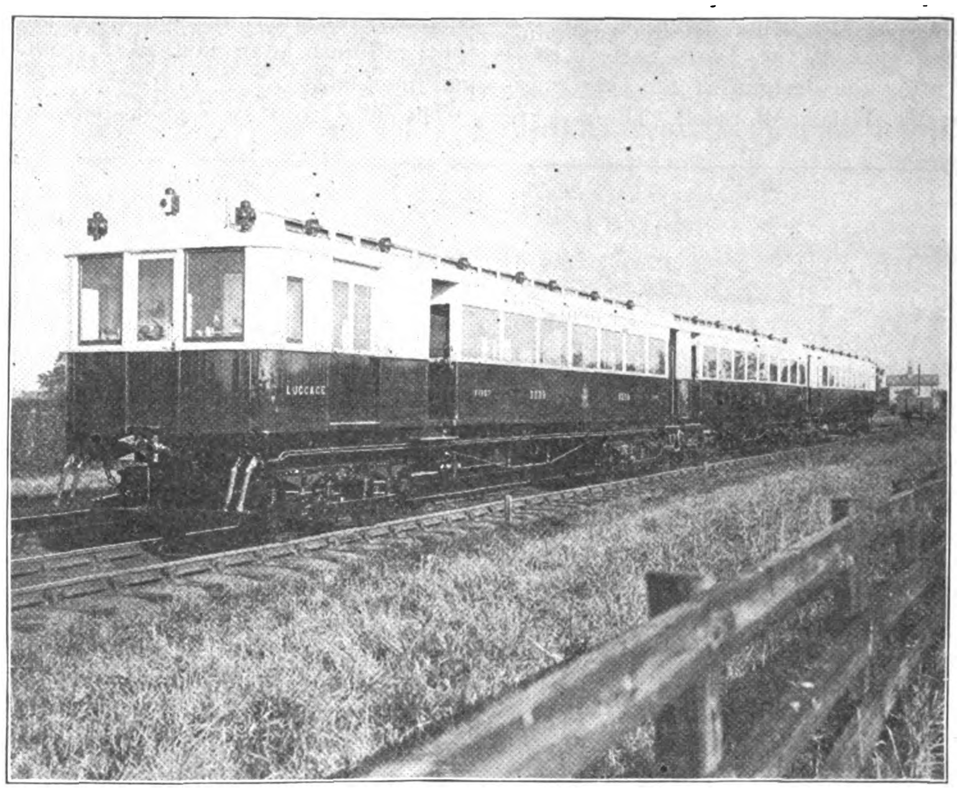

Fig. 1.—Electrically Operated Trains on the North-Eastern Railway.

A number of electrically operated switches are located between each motor car for properly connecting the motor winding and for varying the resistances step by step as desired. These switches are controlled by current conducted through a nine-wire multiple cable which runs from one end of each motor coach or trailer to the other with coupling devices at each end. By this arrangement, there is a continuous nine-wire cable from one end of the train to the other, and by operating any master controller the corresponding electrically operated switches on all of the motor cars are moved at the same time.

The cars are being equipped at the York Works of the North-Eastern Railway after the designs of the chief engineer, Mr. Wilson Worsdell. The cars are each operated by two General Electric 66 motors having a total capacity of 300 hp. Both of these motors are carried on one four-wheel bogie truck and each motor car is carried by two of these trucks, constructed after the designs of the chief mechanical engineer, Wordsell, by the Brush Electrical Engineering Company. The electrical train shown in Fig. 1 is heated and lighted by electricity and on a recent test easily attained a speed of 45 miles per hour. The average speed including stops is about 22 miles per hour for an accommodation train, the total time required for the trip between Tynemouth and Newcastle, a distance of about 8 miles, being 23 minutes. The high speed through passenger trains make the trip without stops in about 15 minutes. The electric locomotives operating on the North-Eastern Railway Quayside Branch Freight Line are capable of hauling a train of 300,000 lbs. up grade at a speed of 9 to 10 miles an hour, and of starting such a load up a gradient of 1 in 27 when necessary. These locomotives are equipped with multiple unit controllers and Westinghouse air brakes, the same as the motor cars. Each motor car is provided with four contact shoes for collecting the necessary current from the third rail. One of these contact shoes is arranged on each side of each bogie truck, and all of the contact shoes on the train are connected together. This obviates the possibility of the train losing its supply of current, even where the continuity of the third rail must be broken, as at crossings and junctions.

The third rail is of Vignoles section and is made of high conductivity steel weighing 80 lbs. per yard. The third rail is mounted on insulators placed about 4 feet from the center of the track, outside of the running rail. The third rail is not protected except at stations where two creosoted boards are bolted against distance pieces on each side of the rails, the same arrangement also being used at level crossings. The current is returned at present through the track, but the third rail has been so placed that a special return rail can be installed between the running rails at any time in the future should this be found desirable. It was found necessary to replace the standard fish-plates by new ones of special design in order to allow sufficient space between them and the web of the rails to admit of the use of protected bonds. The accompanying illustration, Fig. 2, shows the foundations of the Carville power station, including those for the steam turbines and generators as well as the boiler equipment. The electrical equipment of the sub-stations is being constructed by the British Westinghouse Electric & Manufacturing Company, Ltd., while the electrical equipment of the rolling stock and the permanent way is being supplied by the British Thomson-Houston Company, Ltd.

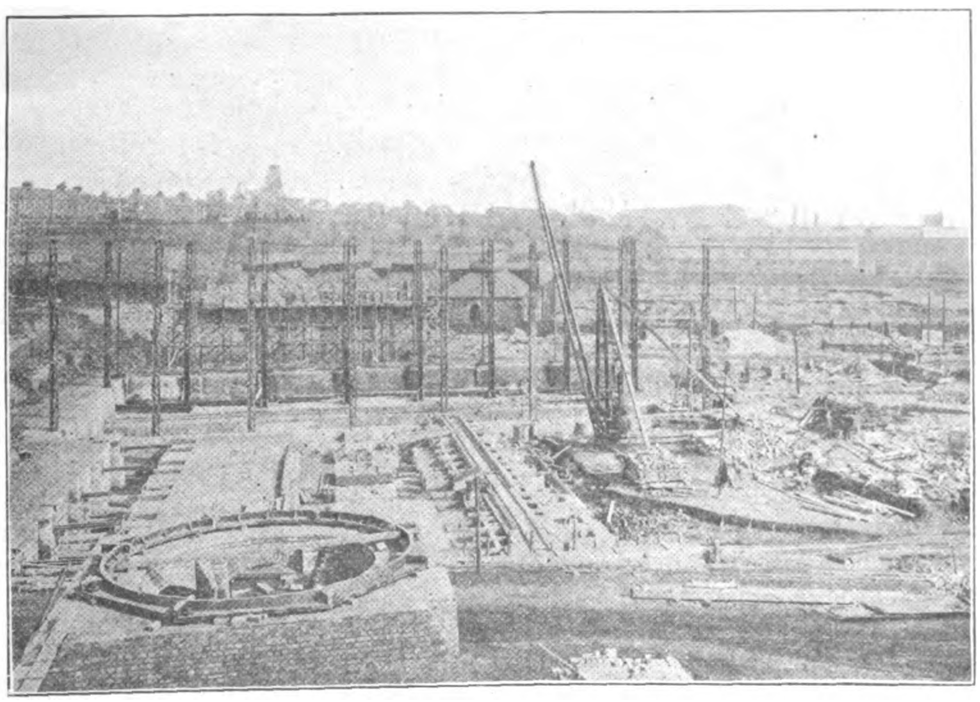

Fig. 2.—Steam Turbine and Generator Foundations of Plant for Furnishing Power to Trains of North-Eastern Railway.

INCANDESCENT LAMPS IN GENERAL, THEIR SMASHING POINT IN PARTICULAR.*

BY GEORGE C. KEECH.

It is my desire to present to you today a paper on incandescent lamps which will clearly describe the results of considerable effort along new lines long desired, but never before accomplished.

Carl Hering, 10 years ago, coined the phrase "Smashing Point," which has been part of the electrical nomenclature since that date. This expression had the excuse which gives all slang a place in our language. It filled a want.

The leading minds in the industry had long appreciated that incandescent lamps were kept upon circuits long after they had outlived their usefulness.

This half descriptive phrase invited explanation and discussion. In an incredibly short time the idea that 80 per cent. of the initial candle power of a lamp was the limit of its useful life was universally adopted.

From the very birth of this expression came the thought that the next step toward the ideal lamp was to make a lamp which would automatically die when it had lived out its usefulness.

We have recently said "If incompetent employes would discharge themselves automatically, business would be easier." I intended to draw a homely comparison between an incandescent lamp and a horse, from an experience of a few summers ago in Michigan.

A central station friend of mine asked me to drive over and help him test out some lamps which he was removing from his lines with the idea of culling out the dim ones. I noticed in the yard near the barn a very lame horse. I questioned the man, and he stated that about five years before this horse had broken its leg, and although it was unfit for work, he had kept it and fed it just because it was a good horse once.

In testing out my friend's lamps, he

* Paper read at the twelfth annual convention of the Northwestern Electrical Association held at Milwaukee, Wis., Jan. 20-22, 1904.

brought forth a peculiar looking specimen and said he had taken it from a minister's study table, much against the latter's wishes. He said: "Don't take that lamp away, it is the best one I have in the house, an old standby, I have had for five years." It tested $6\frac{1}{2}$ cp. at 85 watts. Then I thought of the horse, and have never forgotten either.

Now a perfect horse, from the time it was purchased, would do a certain amount of work daily at the same expense for food and attention and continue this indefinitely. A perfect incandescent lamp would likewise burn forever at its initial candle power, and with the same hourly consumption of current.

As neither horse nor lamp is capable of such a performance, and the tendency of both is to decrease gradually in usefulness until finally the cost of maintenance is more than the actual profit to the owner, the next best condition would be for them to continue for the longest possible period at a good average profit and then die.

Until recently this has been held as an ideal performance for a lamp, but it has been the general opinion that there comes a time when the horse should be shot and the lamp smashed.

The trouble is that the user will not carry out this idea, but lets the lamps burn until they are dim, and condemns the company which furnished the current.

Every station is troubled with poor lamps and to obviate this many companies go to the expense of periodical renewals.

Although this expense is apparently heavy, there are cases on record of 8 per cent. dividends being paid by companies who have renewed all the lamps on their lines as many as four times a year, and their customers have always had bright light.

Alexander Dow, of the Detroit Edison Illuminating Company, has stated that 90 per cent, of customers' complaints could be traced to dim lamps.

Dim lamps is one of two things and sometimes both. They disgust the user by their pale yellow glimmer, or increase his bills because he uses more than he ought; either way the reaction is against electric light and the lighting company.

This dissatisfaction arising from poor illumination makes renewals a necessity.

For those who are interested in the proposition of free renewals, I would refer to a paper read at the National Electric Light Association meeting in Cincinnati in 1902, by a central station manager, wherein he stated that since adopting free renewals he had passed beyond the point of complaint of service. Another stated that he had retained a number of dissatisfied customers by giving them a few new lamps to prove that the trouble was there instead of in the system and by doing this he unwittingly converted himself to the free renewal plan.

Although many companies realize the evil consequences of burning dim lamps, many customers object to the annoyance of frequent renewals and the expense to the company is no small item.

Some recent improvements in the manufacture of incandescent lamps had created such extensive comments that it seems necessary to explain before this convention for the first time the reasons and results of these experiments. It has been said that the filament is the heart of the lamp and the vacuum its lungs.

As to the vacuum, it is now produced by a process of chemical exhaustion, which is considered the only perfect one.

It is well, however, to go into some of the details of the development of the filament which will best lead up to the points in question.

The years 1878 to 1880 saw the inception of what approached nearest to the present incandescent lamp, and since that time the composition of the filament itself has claimed a large share of the experimenters' attention. Various materials have been used. The paper filament of Maxim, the cotton thread of Swan, and the bamboo of Edison were all, however, of cellulose, so that cellulose has been the basis of all lamp filaments since the beginning.

The present cotton fiber is mixed with certain ingredients, formed into a pasty mass and squirted under a high pressure through small apertures into threads whose original diameter before carbonizing is about four times greater than when it is ready to put into the lamp.

The exact composition and exact processes are in a great measure secret, but a general idea may be had from these statements.

Speaking of possible improvements along this line, Dr. Louis Bell, in his work, "Art of Illumination," states: "It may be that we must look to the chemist rather than to the electrician for the final word as to illumination. I may add that the combined knowledge of chemistry and electricity has brought about the results which I shall mention shortly."

A thorough knowledge of chemistry and a complete chemical laboratory are requisites of the modern lamp engineer, and while our physicians are experimenting on remedies to produce certain effects on the human system, our lamp engineers are likewise obtaining results on the filament which, as before stated, may be considered the heart of the lamp itself.

It is here in the engineers' laboratory that the regulation of the life of the filament has been worked out and the automatic smashing point assured.

To refer again to the process of developing the filament from the original cellulose thread; after squirting it is shaped and packed in a crucible with powdered graphite and baked until thoroughly carbonized. Considerable effort is required to make this thread of an even diameter for its entire length.

The process of treating or flashing consists in passing a gradually increasing current through the filament in a bath of hydro-carbon vapor. The hot filament decomposes this vapor from which the carbon is deposited upon it. This process is continued until the thread has received a complete coating of hard, pure, graphite carbon which gives it greater mechanical and electrical stability when operated in the lamp and also makes it of the proper diameter and resistance for the voltage and efficiency for which it is intended.

Although the treating is valuable yet a proper foundation is necessary and it is to this foundation that great efforts have been given.

All of the above has been explained to show the possibility of changing the value of lamps by skillfully manipulating the filament in its manufacture.

Now to summarize: Customers should have bright light every hour and every ounce of coal should produce good value in light.

Complaints should be stopped by getting dim lights off the circuits.

A consumer should get an average of 90 per cent. of the lamps initial candle power.

It is agreed that a lamp is useless after it has depreciated 20 per cent. As every one realizes that it is economy to remove a lamp at this point and, as but few practice it, the only really economical lamp to use is one which will burn out at or near its smashing point.

If, then, it were possible to have lamps automatically extinguish themselves, when they had fallen to this point where they were no longer economical, say at 20 per cent. below their initial candle power, one great step toward the final polarization of electric lighting would be accomplished.

Exactness is not possible but lamps are made which will burn out very close to such a point, and the important result is practically obtained.

Such lamps will smash automatically and must be renewed. There is no room

for forgetfulness. A renewal cannot be neglected.

COLLAPSING PRESSURE OF TUBES AND FLUES.

ARTICLE IV.

BY W. H. WAKEMAN.

Fig. 4 illustrates the ends of two flues flanged and riveted together in compliance with the law relating to such flues. The flanges must be not less than 2.5 inches deep and strengthening rings must be inserted between the flanges as shown. These rings may not be less than one-half inch thick and 2.5 inches wide. The joints between this ring and the flanges may be caulked on both inside and outside thus making them perfectly tight. When built in accordance with these specifications the safe working pressure is determined by the following formula:

$$\frac{89{,}600 \times t^2}{L \times d} = P.$$

t = thickness in decimals of an inch.
L = length of section in feet.
d = diameter of flue in inches.
P = safe working pressure.

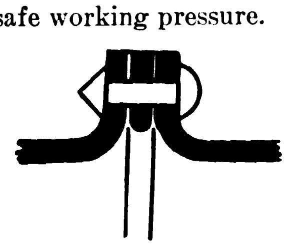

FIG. 4.

Application of this formula to four specimens of flues made in sections 4 feet long gives the following safe working pressures:

14 inch flue	.35 inch thick,	196 pounds.	
16 "	" .37 "	" 191 "	
20 "	" .4 "	" 179 "	
40 "	" .6 "	" 201 "	

This form of construction is known as the Adamson ring, in honor of Mr. Adamson who invented it more than 50 years ago and subjected it to severe tests in proving its value. It has also stood the more valuable test of long use in practical service.

Fig. 5 illustrates another plan for fastening sections together, which adds much to the strength of a plain flue. It represents the ends of two sections about one-half inch apart, covered by a ring made of tee iron substantially riveted to both sections.

Fig 6 shows another form of joint made by riveting a ring of steel, that is hoop-shaped, to both sections. This also adds to the strength of a plain flue, and it admits of expansion and contraction to a limited degree, caused by heating and cooling the boiler.

Fig. 7 is a section of a flue strengthened by a ring made of angle iron, which must be made and applied according to the following specifications: The angle iron may not be less than 2.5 inches deep and it must be at least twice as thick as the material composing the flue. It must be

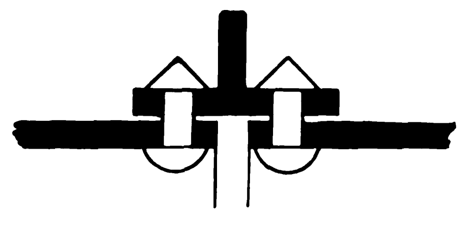

FIG. 5.

substantially riveted in position with wrought iron thimbles between flue and ring. These thimbles are not to be more than 2 inches long, and the rivets passing through them are to have a diameter of at least one and one-half times the thickness of flue. The pitch of these rivets must not exceed 6 inches measured on the outer surface of ring. This ring and flue are illustrated in Fig. 8, in which one-half of each is shown with rivets between them. The thimbles make the bodies of these appear as large as the heads, but this explanation will make the matter plain.

The safe working pressure of flues shown in the four previous illustrations is determined by the last formula given, which was applied to Fig. 4.

To determine the proper diameter of a flue made in sections, when the other conditions are stated, the following formula may be used:

$$\frac{89{,}600 \times t^2}{L \times P} = d.$$

t = thickness in decimals of an inch.
L = length of section in feet.
P = safe working pressure.
d = diameter in inches.

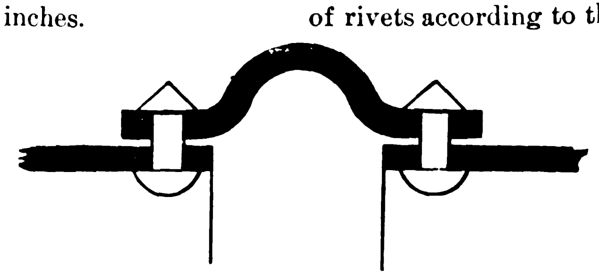

FIG 6.

Applying this to the case of a flue made in sections 4 feet long and .37 inch thick, to carry 191 pounds pressure, gives this result:

$$\frac{89{,}600 \times .37^2}{4 \times 191} = 16 \text{ inches.}$$

To determine the length of sections, when other dimensions are given, this formula applies:

$$\frac{89{,}600 \times t^2}{d \times P} = L.$$

Taking a flue 20 inches in diameter made of iron .4 inch thick, to carry 179 pounds pressure, results as follows:

$$\frac{89{,}600 \times .4^2}{20 \times 179} = 4 \text{ feet long.}$$

Suitable thickness of material for such a flue, when all other data are presented, can be determined by the next formula:

$$\sqrt{\frac{d \times L \times P}{89{,}600}} = t.$$

This shows that a 40 inch flue, made in sections 4 feet long to carry 201 pounds pressure, must be

$$\sqrt{\frac{40 \times 4 \times 201}{89{,}600}} = .6 \text{ inch thick.}$$

There is still another plan for strengthening flues, which consists of a ring made of half round iron and riveted to the flue. This is illustrated in Fig. 9, showing a section of flue and of ring, also a rivet and a thimble between ring and flue. In order to meet the requirements of the U. S. Board of Supervising Inspectors

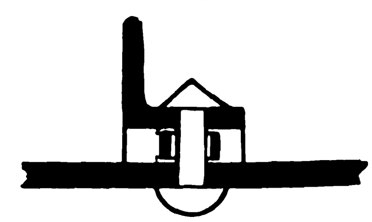

FIG. 7.

the following specifications must be observed:

The area of cross section of half round ring must equal 9.6 times the thickness of material in the flue, and the thimbles must not be more than 2 inches long at their shorter points. No rivets less than ⅝ inch in diameter shall be used, and the pitch measured on the outer surface of ring shall be based on the diameter of rivets according to the following table:

For ⅝ inch rivets, pitch = 4 inches.
For ¾ " " " " 6 "
For ⅞ " " " " 8 "

The diameter of half round iron to be used for this purpose is to be found by means of using the following formula:

$$\sqrt{\frac{.6 \times t \times 2}{.7854}} \quad d.$$

t = thickness of material composing the flue.

d = diameter of half round iron.

For a 40 inch flue made of iron .6 inch thick the half round iron must be not less than 3.8 inches in diameter.

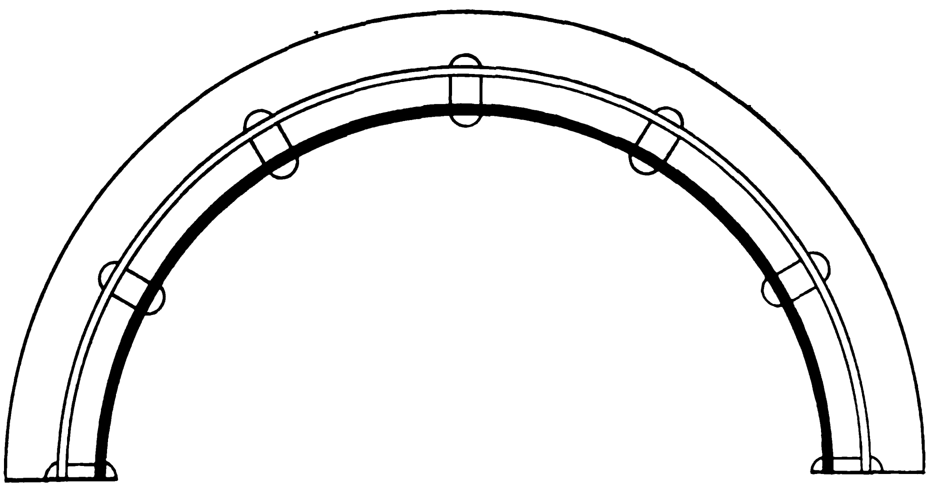

FIG. 8.

Practically the same result may be obtained by multiplying the constant 24.5 by the thickness of the material and extracting the square root of quotient.

The safe working pressure for a flue strengthened by rings made of half round iron is determined by the next formula:

$$\frac{89,600 \times t^2 \times .75}{L \times d.} = P.$$

It will be noted that this contains one more constant than is found in the formula given for determining the safe working pressure of a flue made in sections, and this is the only difference: The result of introducing this constant is to reduce the safe working pressure to three-quarters of that obtained by the above mentioned formula.

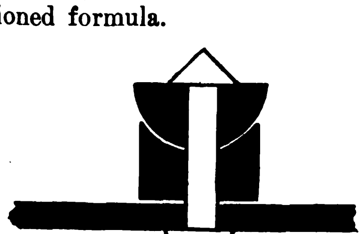

FIG. 9.

The three following formulas are to be used for the purposes stated, in connection with flues strengthened by half round angle iron rings:

Diameter of flue—

$$\frac{89,600 \times t^2 \times .75}{L \times P} = d.$$

Length of sections measured from center to center of rings—

$$\frac{89,600 \times t^2 \times .75}{d \times P} = L.$$

Thickness of material—

$$\sqrt{\frac{d \times L \times P}{89,600 \times .75}} = t$$

This concludes what may properly be called a full review of all important formulas given us for use in relation to boiler tubes and flues.

LONDON'S NEW TUBE RAILWAY—THE GREAT NORTHERN & CITY SYSTEM.

(From our London Correspondent.)

On Wednesday, January 12, a company of London technical and newspaper press representatives went for a trial run on the fourth completed electric railway constructed under the English metropolis on the twin-tunnel principle. The system differs in many respects from the three-tube railways which have been working for the last few years, as the following particulars will show:

Although it is some 14 years since the act for the Great Northern & City Railway was approved by Parliament, it was not until 1899 that it was possible to commence constructional operations, because the nervousness of financial men and public investors prevented the raising of the necessary capital in the earlier years. The work of construction has therefore taken four or five years, and trains are to run for public service early this month.

The line connects the important Great Northern station at Finsbury Park, just at the London four-mile radius, with the heart of the city in an almost straight line. It is calculated that shortly after opening the Great Northern & City will be carrying about 27,000,000 passengers per annum. The Central London is at present conveying 7,000,000 of passengers per mile per annum. The morning and evening traffic will be the chief "loads," and when the traffic eases off in the middle of the day shorter trains will be run, this requirement, more than anything else, having weighed with the directors in adopting the multiple unit system. The line is 3½ miles long, and there will be a three minutes service, the single journey being completed in about 13½ minutes, including four intermediate stops of 20 seconds each. The trains will be worked on the shuttle principle at the termini, thus avoiding shunting round the end of the station.

The tunnels are of unusually large diameter, i. e., 16 feet, as against 11 feet 8 inches on the Central London Railway, and 10 feet 6 inches on the City & South London. The advantages of this are obvious. Despite the larger size of the tunnels, we are told that the capital expended per mile is about the same as that of the Central London. Special attention has been devoted to the safety of the public, and one direction in which this is to be seen is in the great width and ample proportions of the stairs and the passages by which they are approached.

A word may be said as to the method of driving the tunnels, a somewhat more powerful type of shield than has been usually employed in works of this class having been adopted. The modern shield, as at present used, is of the nature of a cheese taster in its method of boring, and slides upon the completed cast-iron tube which is constructed within its thin steel after end, much as the cap of a telescope does upon its body. It is pushed forward by powerful hydraulic rams which press against the last completed ring of the cast-iron tunnel. In order to minimize the amount of noise and vibration, a vitrified blue brick invert has been introduced for a very great proportion of the length. It has been demonstrated during the trial runs that the introduction of this material, combined with a cast-iron roof, will have this effect. It is less resonant than the complete iron rings, and the fact that the tube is constructed of a combination of such different materials is claimed to make the transmission of the waves causing sound more difficult, with a consequent saving in noise.

As to fire-proofing precautions, these have been well taken, even the signalmen's cabins being fire-proof structures, and the platforms are of solid concrete and iron construction.

Now as to the rolling stock, and the power station equipment.

Each train is composed of seven coaches (each 50 feet long), and the width is equal to that of the widest carriages that can be run over any British railway, viz., 9 feet 4 inches. The height is 12 feet 2 inches. As the length of the station platforms is about 450 feet, for the terminal,

and 420 feet for the way stations, ample margin has been allowed for the lengthening of the trains should the growth of traffic necessitate.

Three of the coaches per train are motor-coaches and four are trailers, the seating capacity of the whole being about 430 passengers. Each motor coach has two motors, one upon each truck, rated 125 hp., and built by the General Electric Company of Schenectady. The carriages were built by the Preston Company and the Brush Company, and they have Westinghouse quick-acting brakes. The multiple unit system adopted is the same as on the Central London and on the New York Elevated, and the British Thomson-Houston Company of Rugby designed and carried out this part of the undertaking, and in fact all the rest of the electrical plant.

The cariages are teak structures with steel underframes and are of the corridor type. They have a novelty in the shape of a central door, which will enable unloading to be expeditiously carried out at terminal stations. These doors are so arranged that they cannot be opened from the carriage itself, and therefore there is no danger of a passenger opening them and leaving them open at any way station. They will be opened by special porters at the termini.

The generating station is situated alongside the Regent's Canal, from which its water supply for condensing, etc., is drawn. Coal landed from barges is conveyed to the bunkers and fires entirely by automatic machinery.

The main plant consists of four engines built by Messrs. Musgrave & Co. of Bolton, of 1,250 hp. each, of the slow speed, cross-compound, surface condensing type, and they take steam from ten economic boilers made by Davey Paxman. The flywheels weigh 45 tons, and the engines are capable of sustaining momentary overloads of 100 per cent. The generators are of the British Thomson-Houston traction type, and they generate at 575 volts continuous current for feeding to the conductor rails. For the first time on any London railway two such rails are provided, one being placed on each side of the track, outside. This method has been adopted with a view to greater safety and continuity of working.

The tunnel electric lighting is done from an independent source so that in the event of derailing, breakdowns, etc., the tunnels will not be plunged into darkness. There is also an emergency gas lighting service provided in all the stations. A continuous fire-proof concrete gangway has been made so that passengers may safely make their way to the nearest stations in case of necessity.

Lifts have of course had to be provided at stations. Those at the Moorgate Street and Essex Road stations are Easton's electric lifts, but those at Finsbury Park station are electric-hydraulic, they being so designed and made in view of the small amount of headroom.

For the first three years the railway will be worked by the contractors, Messrs. S. Pearson & Son, Ltd. Mr. R. P. Brousson is the engineer-in-chief under the Great Northern & City Railway Company.

ELECTRICAL STATION PRACTICE.

ARTICLE XXII.

BY W. H. RADCLIFFE.

A common form of the alternating current ammeter is that operated by the heating effect of the current. Such instruments are perfectly independent of magnetic conditions and therefore may be mounted without any precautions being taken, near generators, bus bars, etc. They are also independent of the shape of the alternating current wave and of the frequency of the current.

The operation of a hot wire measuring instrument is governed by the change in length of a special wire in the meter, caused by the heat developed therein by the passage of a current through it. This wire in an alternating ammeter is about 6 inches long and is composed of platinum silver. The connections between the binding posts of the meter and the platinum-silver wire are made by a number of silver strips in parallel. Attached to the platinum-silver wire is a phosphor-bronze wire which runs downward to a terminal at the bottom of the instrument; from the phosphor-bronze wire a strong fiber branches off which is looped around a steel drum carrying the pointer. The end of the loop is fastened to a spring which tends to keep it taut, and the drum around which the loop is made is of steel and is mounted in jewels.

The main portion of a current passing through the meter flows through a shunt of low resistance, but a part of it in traversing the platinum-silver wire heats it and thereby causes it to increase in length; this elongation in the platinum silver wire tends in turn to cause some slack in the phosphor-bronze wire, but the slack is at once taken up by the action of the spring on the fiber. The movement of the fiber causes a rotation of the drum around which it is looped, and as the pointer is attached thereto it is deflected over the scale. The amount of the deflection of the pointer indicates the exact number of amperes of current passing through the meter, because the conditions are such that both the heating and elongation of the wire, and consequently the force tending to rotate the pointer, are directly proportional to the strength of the current. Each of these instruments are usually provided with a permanent magnet mounted just above the steel drum; this magnet tends to dampen the movements of the drum so as to make the instrument dead-beat. The term "dead-beat" is one commonly used in connection with electrical measuring instruments and means that the pointer quickly takes up its position of equilibrium under the action of the current, and that when the current is taken off the pointer comes rapidly to the zero position. In the construction of each instrument a short-circuiting switch is introduced for shunting in full the hot wire when not in use; this switch is here used rather to prevent any liability of a burn-out due to an accidental overload, than to eliminate errors arising from the interior heating of the instrument. By means of a small, hard rubber thumb-screw projecting through the side of the instrument, a correct adjustment of the pointer for the zero position may be made without removing the case.

As previously stated it is customary in this type of alternating current ammeter to introduce a shunt of low resistance for the passage of the main portion of the current. In the portable meters this shunt is contained within the case of the instrument, but in the station type of alternating current ammeters the shunt constitutes a separate piece and can then be placed wherever it is most convenient, although it is usual on account of a saving in copper to limit the distance between the meter and shunt to 40 inches. By providing different shunts for a station ammeter the same instrument may be arranged to measure currents which differ considerably in value. It is then convenient to have separate graduations on the scale for each shunt, but if desired only one scale may be used and the readings thereon multiplied or divided according to the ratio between the shunts. In this manner an ammeter having a capacity of 5 amperes might, by the aid of a shunt, be made to have a capacity of 5,000 amperes.

Alternating current circuits are frequently designed to carry very high pressures. When the difference of potential employed is greater than 3,000 volts the shunts used in connection with station ammeters are replaced by series trans-

formers of which there are three types. One form known as the dry type is for use on circuits up to 10,000 volts with from 15 to 300 amperes of current; another form in which the coils are surrounded by oil is designed for pressures between 10,000 and 30,000 volts with currents up to 200 amperes, and the third form for pressures up to 10,000 volts with currents between 400 and 1,000 amperes is constructed of two coils of wire which surround one of the bus bars, the coils constituting the secondary winding of the transformer and the bus bar the primary. The passage of the current through the bus bar induces an electromotive force in the secondary coils. These coils being connected to the alternating current ammeter, the electromotive force causes a current to pass through the hot wire of the instrument and the effect thereby produced is a measure of the current strength. As the hot wires in all station ammeters of this type are designed to carry but 3 amperes, this is the maximum current that series transformers used for the purpose mentioned are constructed to give in their secondary coils.

Another form of alternating current ammeter frequently met with in practice is the Thompson inclined coil ammeter. It is simple in construction, consisting of one coil of wire connected between the binding posts and mounted in an inclined position of about 45 degrees with the horizontal. It is held in this position by an iron support which also contains the bearings for the movable part, together with the spiral springs attached thereto. The movable part is surrounded by this coil, and is composed of an oblong piece of soft sheet iron which acts as a core of the coil and is mounted on a spindle at an angle of 45 degrees. The spindle also carries the pointer which is fastened to it so that when the sheet iron piece lies in the plane of the coil the pointer will indicate zero on the scale. Upon the passage of a current through the meter, the magnetic field developed by the current in the inclined coil tends to cause the sheet iron piece to place itself at right angles to the plane of the coil, so that the lines of force may travel through it lengthwise. The change in position of the sheet iron causes the spindle to which it is attached to rotate, and consequently to deflect the pointer over the scale, the amount of deflection in any case being proportional to the number of amperes of current. As soon as the current is discontinued through the instrument the spiral springs attached to the top and bottom of the spindle pull it back so the pointer returns to its zero position.

The portable ammeter of this type is usually provided with an arrangement for causing the pointer to come rapidly to rest, for owing to the reversals of the current causing fluctuations of the pointer there is often considerable time occupied in obtaining a satisfactory reading. The apparatus which is used to reduce these fluctuations consists of a frame carrying a tightly stretched string, the frame and string together resembling a violin bow. This is mounted at right angles too, but on a rod which can be made to slide up and down in a vertical support by the respective pressure of a spring underneath, or by the pressure of the hand on top. The rod terminates in a button which projects through the case of the instrument, and when this is pressed down the string previously mentioned presses against the pointer, which latter travels in a horizontal position between the frame and the string, and the pressure tends to stop the vibrations of the pointer. Upon releasing the pressure of the hand or finger on the button, the compression of the spring forces the rod upward; the frame and string attached to this rod is therefore raised, and the pointer being released from contact with the string settles quickly to rest. It is, of course, necessary that when readings are taken the pointer be free to assume its own position as determined by the currents passing through the instrument.

The only remaining type of electrical measuring instrument to be considered is the wattmeter. This meter, like the others considered, is made in two forms, so there are portable wattmeters and station wattmeters. The former are designed to measure the value of the electrical power in watts supplied to a circuit at any one time, whereas the latter are designed to record these values for a given length of time. The portable wattmeter contains two main circuits, one of which is of heavy wire to be connected in series with the wires of the outside circuit and serves to measure the current in amperes, while the other circuit through the meter is of fine wire to be bridged across the load and serves to measure the pressure of volts. Binding posts are, of course, provided for connection to each of these circuits. The heavy wire circuit for measuring the current is simply used for establishing a field within which a movable coil is mounted. The fine wire circuit for measuring the pressure is also formed into two coils for developing a field, but these coils are wound in opposite directions to those composed of fine wire in order to neutralize the deflection that would otherwise be caused when the load circuit was open, by the movable coil which carries the pointer, and also forms a part of the fine wire circuit. A deflection of the pointer over the scale indicating a certain number of watts with simply t he pressure coil in circuit would be incorrect, since with zero current the number of watts which are proportional to the product of volts and amperes, should also be zero. The pressure circuit contains in addition two field coils and the fine wire movable coil, a key for opening and closing this circuit, and a high resistance, the latter of which serves the same purpose as the high resistance introduced in any voltmeter.

It is therefore obvious from the construction that a portable wattmeter is in reality an alternating current voltmeter and an ammeter combined into one instrument. As in the other instruments described, spiral springs attached to the movable coil cause it and the pointer mounted thereon to return to their respective zero positions when the circuit through the instrument is opened. If it be desired to increase the capacity of this wattmeter, a multiplier used in connection with the pressure circuit may be used to accomplish the result in the same manner as with direct or alternating current voltmeters.

On many switchboards, station wattmeters, or recording wattmeters as they are usually termed, are installed to measure and record on dials attached to the instrument the number of watt hours of power supplied to the consumers. By watt hours is meant the product of the pressure in volts, the current in amperes, and the duration of flow in hours. The recording wattmeter is in reality a small electric motor. The only special feature introduced in its construction is in the field magnets which are formed by coils of wire without iron cores. These coils are connected in series with the wires of the outside circuit for obtaining the effect of the current, while the armature winding is by means of small platinum tipped brushes and a commutator, supplied with the main voltage. A high resistance is introduced in the pressure circuit as in the previous case, and at the lower part of the vertical spindle upon which the armature is mounted a flat copper disk is fastened. This disk therefore revolves with the armature, and travels between the pole pieces of two permanent magnets mounted on the base of the meter. The lines of force of the permanent magnets being cut by the disk as it rotates, causes a difference of potential to be established in the disk, and this in turn causes eddy currents, which reacting on the iron of

the magnets exert a retarding influence on the motion of the plate. The effect thereby produced is precisely the same as a load on the motor. This increases the current through the motor, but since the eddy currents increase as the square of the speed, their effect entirely neutralizes that caused by a greater field strength, so that the speed of the armature in revolutions per minute is directly proportional to the current passing.

By means of a worm gear the motion of the armature shaft or spindle is communicated to a series of counters which are mounted to the top of the frame, and these are geared together in a ten to one ratio so that the number of watt hours may be read directly in tens, hundreds, thousands, etc. Sometimes the readings on the dials of the counters must be multiplied by a constant in order to obtain the correct number of watt hours. The constant is rendered necessary when it is desired to keep the speed of the armature at the same value regardless of the size of the meter, and the dials on all instruments also of the same size. Owing to the absence of iron in the construction of this wattmeter, it may be used on alternating current circuits as well as on direct current circuits with no alterations whatsoever.

With careful usage the recording wattmeter will not be found troublesome. The most common defects are excessive pressure of the brushes on the commutator, or abnormal friction at the lower bearing. The former trouble may be remedied by properly adjusting the brush holders, but the latter defect usually necessitates the substitution of a new jewel for the bearing, in place of the old one. If it be found that the indications on the dials of the counters are lower than they really ought to be, the speed of the armature should be increased by moving the magnets nearer the center of the disk. In this position there are less lines of force cut by the revolving disk, so that the load on the motor is diminished and the speed consequently increased.

RADIUM.*

BY PROF. R. A. MILLIKEN.

Roentgen's discovery of the X-rays would not have caused popular interest had it not been associated with the suggestion of the possibility of taking photographs of the human skeleton, and that idea was so strange, so uncanny at the time, that the discovery immediately took to itself wings, and inside of two weeks had set the whole world, popular as well as scientific, agog, and physicists began to experiment on these strange new rays. As a result of all this experimentation, very little that was new was added to our stock of knowledge regarding the nature of X-rays, for X-rays are now practically as unknown a quantity as they were when Roentgen first discovered them; but as is so often the case, this wave of experimentation bore fruit in unexpected directions, and one of the side products of that experimentation was a discovery in many respects infinitely more important, the discovery of the fact of radio-activity.

It came about in this way: When a discharge passes through an X-ray tube you are all aware, I presume, that the tube lights up with a sort of greenish light, which is called in physics a fluorescent light. X-ray photographs were taken by exposing a photographic plate with a hand in front of a tube of this sort, and the suggestion was early made that the X-rays themselves might be due to some sort of rays due to this greenish fluorescence, and, if so, we ought to get X-rays from other substances.

Now there are a number of minerals in nature, particularly uranium, which have this property of glowing with a yellowish green light when exposed to the actinic rays of the sun.

It was only a few months after Roentgen announced his discovery when Henry Becquerel made a radiograph with uranium rays, exactly the same as is done with the X-rays, except that that the exposure required was much longer, and by means of his experiments the discovery was made of the phenomenon of radio-activity which has added so much to our interpretation of the constitution of matter.

Some months after this Madame Curie, who is one of the few women who has ever attained eminence in the pursuit of science, but who must be placed in the front ranks of scientists of the present day, investigated all the then known elements in order to see whether any of the others of them possessed the strange properties which Becquerel had found in uranium, and she found that thorium and all its compounds (and that is one of the ingredients of our ordinary Welsbach mantle), and none of the other known elements possessed this property of radio-activity.

But in connection with this investigation she noticed one strange thing, and that is, that pitchblende, the crude ore from which uranium is obtained and which consists largely of uranium oxide, had the property of discharging electricity about four times as fast as pure uranium salt, or pure thorium salt, and she inferred from this that the discharging effect of the pitchblende was not due to the uranium alone in it, but that it must be due to some hitherto unknown element which had the same property which uranium possessed. She therefore proceeded by qualitative analysis to separate the 20 or more different ingredients contained in pitchblende. The search was very difficult, but ended triumphantly for Madame Curie, in the separation from two to three tons of pitchblende of two or three grains of an exceedingly active substance which she named radium, and which has recently become one of the wonders of the world, because of its most remarkable properties; although they are in no way different from properties of uranium and thorium, except that it has those properties in a higher degree.

I have 10 milligrams of pure radium bromide, which have been obtained by this extremely difficult process. This is so small an amount that it does not seem to be much of anything, yet this costs on the market $60.

Now I must call your attention away, in order to explain the properties of radium and radio-active substances, from the immediate consideratian of radio-activity to some of the other discoveries that followed upon the discovery of the X-rays, and were a consequence of them, because we shall have to understand the properties of what are called cathode rays to understand how people experimented upon these rays from radio-active substances to determine their nature.

For a long time there was much dispute as to what the nature of cathode rays was; they were thought by some to be some form of invisible light rays, being propogated in straight lines; others maintained that these rays were not light rays at all, that is, they had nothing to do with the ether, but that they consisted of streams of particles shot with enormous velocities in straight lines through the tube.

In 1898 a number of experiments were performed which show that the cathode rays are not light rays, but that they are projected particles. In all such circumstances a body which is put in the path of those rays is negatively charged, showing that they are negatively charged particles; and they are repelled by the negative and attracted by the positive pole of a magnet.

These experiments show that the cathode rays consist of negatively charged particles expelled at enormous velocities

*Lecture delivered at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

from the negative electrode in the cathode tube. This is now an admitted fact.

We can calculate from the amount of deflection of a magnet of known strength and the amount of deflectien from electrical charges of known strength, first the velocity of the particles, and second their mass. When that calculation is made it shows the velocity is something like 20,000 miles per sccond. But the size of the particles is a surprising thing. They are not atoms and they are not molecules, but their size is about 1-1,000 of an ordinary hydrogen atom, the smallest atom thus far known.

These experiments upon cathode rays showed that under some circumstances particles exist which are smaller than the smallest atoms known to chemistry, and very much smaller, and they suggested for the first time in the history of man the possibility of breaking up the atom into small parts.

I will introduce here a speculation resting on a certain amount of experimental evidence, on account of the fact that the size of these cathode particles is always the same; no matter what the nature of the gas or electrode is, it is certain that these particles are constituents of all known metals and of all the gases that can be experimented upon here, and therefore probably of all substances. J. J. Thompson has brought forward, therefore, the hypothesis that we have here the primordial atom from which all our ordinary atoms are built up.

The hypothesis therefore is the atom of hydrogen consists of about a thousand of these cathode particles called electrons, and the mercury atom would be about 200,000, and the oxygen atom 16,000. That is, the various atoms of chemistry would simply be complexes of these cathode particles, each atom containing a number corresponding to its atomic weight.

(To be continued.)

Meeting of Standard Underground Cable Company.

The annual meeting of the stockholders of the Standard Underground Cable Company was held at the general offices of the company in the Westinghouse Building, Pittsburg, Pa., on January 26.

The statement of the company's operations for the year was presented, showing that the company did a gross business of nearly $9,000,000 during the year 1903, that dividends were paid on its capital stock aggregating 12 per cent., and that the company's assets aggregate the handsome sum of $3,604,457, with only $375,344 of liabilities, apart from capital stock. It has no outstanding notes, mortgages, bonds or preferred stock.

The board of directors elected for the ensuing year is as follows: Mark W. Watson, John B. Jackson, James H. Willock, Robert Pitcairn, J. N. Davidson, John Moorhead, B. F. Jones, Jr., Joseph W. Marsh and W. A. Conner. The only change in the board is represented by the election of W. A. Conner, who has been at the head of the manufacturing department of the company since 1884.

The meeting of the board of directors for the purpose of organization was held on January 29 and the former officers were re-elected as follows: Mark W. Watson, president; Joseph W. Marsh, vice-president and general manager; Frank A. Rinehart, treasurer, and C. M. Hagen, auditor.

This company was the pioneer in the manufacture of underground cables for all classes of electric service, having been formally organized in January, 1882, although much experimental work had been done by Richard S. Waring, the founder of the company, prior to its organization. Its reputation for high class manufacture in each of its departments, comprising bare copper wire, weatherproof wires and cables, rubber insulated wires and cables, and both paper and rubber insulated lead covered cables for telephone, telegraph, electric light and power service, together with the favorable location of its factories, Perth Amboy, N. J., Pittsburg, Pa., and Oakland, Cal., and its strong financial condition, place it in a most favorable position to command a large business in its various lines.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JANUARY 26, 1904.

Electric Railways and Appliances.

750,247. Mono-Railway and Truck Therefor. Lina Beecher, Batavia, N. Y., assignor to the Beecher Construction Company. Filed March 6, 1903.

750,296. Electric Railway Signal. William V. Moak, Albany, N. Y. Filed Dec. 8, 1902.

750,368. Trolley for Electric-Railway Cars. Charles J. Johnson, St. Louis, Mo., assignor of one-half to Charles W. Benedict, same place. Filed May 14, 1903.

750,458. Overhead-Trolley Attachment. Charles Holyland, Sr. Pittsburg, Pa. Filed June 6, 1903.

750,510. Process of Forming Electrical Rail-Bonds Directly in Place on the Rails. William H. Wherry, Cleveland, O. Filed Jan. 22, 1903. Renewed Oct. 1, 1903.

750,719. Car-Fender. Emil Sprich, St. Louis, Mo. Filed Aug. 28, 1903.

750,733. Trolley-Pole. John J. Tartt, Los Angeles, Cal. Filed March 30, 1903.

Electric Lights and Appliances.

750,554. Ballast Device for Vapor-Lamps. Henry N. Potter, New Rochelle, N. Y., assignor, by mesne assignments, to the Cooper Hewitt Electric Company. Filed Oct. 19, 1901.

750,720. Incandescent Lamp. Walter A. Springall, San Antonio, Tex. Filed June 25, 1903.

Electrical Machinery and Apparatus.

750,261. Brake for Vehicles. William H. Cooley, Brockport, N. Y. Filed D 1902.

750,370. Electric Gear for Cranes. Otto Kammerer, Charlottenburg, Germany. Filed May 11, 1900.

750,421-750,422. Electric Brake. George C. Anthon, Medford, Mass., assignor, by mesne assignments, to the Algonquin Electric Brake Corporation, Boston, Mass. Filed Nov. 30, 1901, and April 11, 1902.

750,434. Electric Brake. Perley P. Crafts, Boston, Mass., assignor, by mesne assignments, to the Algonquin Electric Brake Corporation, same place. Fled Nov. 29, 1899.

750,509. Electrical Conductor. William H. Wherry, Cleveland, O. Filed Nov. 3, 1902. Renewed Oct. 1, 1903.

750,525. Transformer. Augustine R. Everest, Lynn, Mass., assignor to the General Electric Company. Filed Aug. 11, 1902.

750,765. Electric Motor. Thaddeus W. Heermans, Chicago, Ill. Original application filed Dec. 4, 1899. Divided and this application filed Jan. 22, 1900.

Telephones and Telephone Apparatus

750,309. Annunciator. Lambert Schmidt, Weehawken, N. J. Filed Aug. 28, 1901.

750,689. Plug for Telephone-Switchboards. Frank D. Pearne, Chicago, Ill., assignor to Pearne, Krum & Co., same place. Filed April 20, 1903.

750,704. Telephone Switching and Signaling Apparatus. Malcolm C. Rorty, Dedham, Mass., assignor to the American Telephone & Telegraph Company. Filed Jan. 3, 1902.

750,769-750,770. Telephone-Service Apparatus. Uriah S. Jackson, Ossipee, N. H., assignor to the Superior Autumatic Telephone Company, Boston, Mass. Filed May 31, 1902, and April 22, 1903.

Miscellaneous.

750,250. Electric Battery. Winfield S. Bryan, Cincinnati, O. Filed Sept. 28, 1903.

750,268-750,269-750,270. Electric Signaling Apparatus. William E. Decrow, Boston, Mass. assignor to the Gamewell Fire Alarm Telegraph Company. Filed April 29, 1901, June 17, 1901, Sept. 27, 1901.

750,289. Telegraph Instrument Stand. James W. Leech, Staunton, Va. Filed Jan. 6, 1903.

750,361. Electrometallurgy of Iron or Steel. Henri Harmet, St. Etienne, France. Filed Sept. 30, 1901.

750,429. Wireless Electric Transmission of Signals Over Surfaces. Ferdinand Braun, Strassburg, Germany. Filed Feb. 6, 1899.

750,454. System of Electrical Distribution. Josef H. Hallberg, New York City. Filed Oct. 16, 1903.

750,471. System of Electrical Generation, Distribution and Control. Lamar Lyndon, New York City, and Elmer A. Sperry, Cleveland, O., assignors to the National Battery Company, Jersey City, N. J. Filed Jan. 17, 1903.

750,492. Electric Clock. Fred Schmidt, Oak Station, Pa., assignor of one-half to Henry Bauer, Lock No. 3, Allegheny County, Pa. Filed May 9, 1903.

750,496. Spark Telegraphy. Adolf Slaby, Charlottenburg and Georg G. Arco, Berlin, Germany. Filed April 9, 1901.

750,497-750,500. System of Electrical Generation, Distribution and Control. Elmer A. Sperry, Cleveland, O., assignor to the National Battery Company, Jersey City, N. J., and Buffalo N. Y. Filed Dec. 5, 1902, July 1, 1903.

750,498-750,499. Power Transmitting Mechanism. Elmer A. Sperry, Cleveland, O., assignor to the National Battery Company, Jersey City, N. J., and Buffalo, N. Y. Filed March 5, 1903.

750,549-750,550. System of Electrical Generation, Distribution and Control. Lamar Lyndon, New York City, assignor to the National Battery Company, Jersey City, and Buffalo, N. Y. Filed Jan, 22, 1903. Renewed Dec. 8, 1903. Filed July 18, 1903.

750,569. Electric Time Alarm. Theophilous L. Bear, Camden, N. J. Filed Sept. 27, 1901. Renewed Aug. 8, 1903.

750,584. Process of Administering Electrical Vibrations. Fred H. Brown, Los Angeles, Cal. Filed Aug. 25, 1902.

750,646. Combined Electrical Battery Receptacle and Bell Support. William A. Harvey, Scranton, Pa., assignor of two-thirds to Charles Schlager and Walter L. Schlager, same place. Filed Sept. 9, 1903.

750,716. Electric Fan. Adolph T. Smith, New York City, assignor,of one-half to Myron B. Matthews, Passaic, N. J. Filed Aug. 10, 1903.

750,722. Insulator. Louis Steinberger, New York City. Filed May 25, 1903.

750,753. Electric Furnace. Ramon O. Contarda [illegible] France. Filed Aug. 24, 190[illegible]

Reissue.

12,195 Electrical Accumulator. Chaimsonovitz P. Elieson and Vladimir de Bobinsky, Paris, France. Filed Oct 26, 1903. Original No. 692,433, dated Feb. 4, 1902.

THE TELEPHONE WORLD.

Independent Companies Hold Meeting in Nebraska.

The Independent Telephone Association met in Lincoln last month. The programme was composed of the opening address by the president of the State Association, I. D. Clark, of Papillion. Reports of secretary and of committees, and work of a more routine nature followed. The paper of the afternoon session was an interesting one on the subject "Selective Calling on Party Lines," by J. E. Adamson, of Broken Bow, and W. J. Staadelman, of Kearney. The points brought out in the paper were discussed by the members and the new ideas embodied in the reading met with keen approval.

The prime object of the convention was to arrange for a systematic connection of all the Independent lines of the State in such a manner that a call from Lincoln may be made with Fairbury, Plattsmouth, Hastings or any other city where Independent lines are now in operation.

E. C. Hansen, secretary of the Independent Telephone Association, said that plans were on foot for the connecting up every part of the State.

At a meeting of the business men of Springfield, Minn., it was decided to organize the Farmers & Citizens' Mutual Telephone Company. The incorporation will be capitalized at $25,000. The incorporators are: J. S. Schroder, William G. Frank, A. G. Anderson, Ed. J. Fernholf, C. A. Hintz, Albert Prahl, Ernest Altermott. Besides a local system, rural lines will be built at once to connect all of the neighboring towns. The life of the corporation is fixed at 30 years.

The Hopkinsville, Ky., Home Telephone Company was organized a short time ago, by electing R. E. Cooper, president; George H. Metheany, of Lima, O., vice-president; Joseph F. Garnett; treasurer; and F. G. Hoge, secretary. The contract was let to the Ideal Construction Cmpany of Lima, O., for a complete telephone exchange. The company is capitalized at $100,000.

An ordinance was recently adopted granting to Wm. Lehn a franchise to erect poles and wires for the transmission of electricity for telephone and telegraph purposes along the public roads of Sonoma County, Cal., also to the Russian River & Windsor Telephone Company for the same purpose.

A new section of switchboard is being put in at the exchange of the Mutual Telephone Company of Shelbyville, Ind., which will increase the capacity to 1,100 'phones. The lines now between that city and Indianapolis are not sufficient for the service, and a third one is being built.

The Northern Nevada Telephone & Telegraph Company, incorporated by J. G. Taylor, R. H. Mallett and others, capitalized at $10,000, has a telephone line between Tuscarora, Edgemont, White Rock and Columbia, and will extend to other points north.

An ordinance has been passed granting to the Utah Independent Telephone Company a franchise to erect and maintain telephone lines upon the public highways of Weber County.

Reorganizing the Michigan Telephone Company.

The first step in the reorganization of the Michigan Telephone Company, the properties of which were purchased by N. W. Harris & Co., on behalf of a bondholders committee recently, was taken last week in the incorporation of the Michigan State Telephone Company under the laws of that State, with a capital of $25,000 divided into $10,000 accumulative preferred stock and $15,000 common. Under the charter the right is reserved to increase the capital stock, and the voting powers on both kinds of stock are equal.

The incorporaters and directors are William A. Jackson, a founder of the Michigan Telephone Company; John T. Shaw, cashier of the First National Bank of Detroit; James Cullen, and Elliott G. Stevenson, a partner of Don M. Dickinson, who was counsel for the bondholders in Detroit. It is said that the new company will take over the properties of the old one, this process necessitating the satisfaction of the bond claims held by the bondholders as present owners of the property.

The first annual meeting of the York State Telephone Company, since its organization one year ago, was recently held in Binghamton, N. Y. The following officers were elected; President, W. D. Barnard; vice-president, Edward Davis; secretary and treasurer, Robert M. Dougal; general superintendent, George B. Wright. The report of Vice-president Davis to the stockholders showed that the company had increased the number of telephones from 2,461 at this time last year, to 3,617 at present, a growth of 50 per cent. in one year.

Articles of incorporation of a telephone company to operate in Genesee and Orleans Counties, N. Y., with an exchange at Byron, were lately filed with the county clerk. The capital stock is $1,200, and the stockholders are E. I. Cook, I. C. H. Cook, Marshall H. Cook, Burt H. Gall, Charles H. Green, Dr. Messenger, H. C. Norton, Dr. Prince, A. G. Steele, H. C. Walker, F. C. Walker and I. W. White.

The Canton, Pa., council has granted a franchise to the Canton & Leroy Telephone Company, which company will install its system as soon as the frost is out of the ground. While this company is purely a mutual company it will form part of a system of former telephone lines which will reach considerable proportions

At the annual meeting of the stockholders of the Colonial Telephone Company recently held in Newburgh, N.Y., officers were re-elected as follows: S. V Schoonmaker, president; Wm. G. Taggart, vice-president; H. A. Bartlett, treasurer; George G. Otis, secretary and general manager.

The Rhinelander, Wis., Mutual Telephone Company by its president, Samuel S. Miller, and its secretary, H. L. Crawford, lately filed an amendment increasing its capital from $5,000 to $10,000.

An Independent telephone system is to be installed connecting Jackson, Ann Arbor and Ypsilanti, Mich.

Independent Company Busy in New York State.

The Wayne-Monroe Telephone Company has invaded Sodus, and a big exchange will be built, connecting all the villages and towns, using Sodus as the center. General Manager Driscoll, of Rochester, Dr. J. S. Brandt, of Ontario, and J. L. Transue, of Williamson, directors of the company, have signed contracts in Sodus. It has been rumored for some time that this company would invade Sodus.

The Wayne-Monroe Company is known as the Independent Company, and it has recently installed systems throughout the towns of Ontario, Williamson, Walworth and Macedon, in connection with the Independent exchange at Newark, Lyons and Clyde. Its trunk line was completed a short time ago, and it is now connected with Rochester through the Home Company and with 50,000 telephones in Western New York. The line has already been extended to East Williamson, four miles west of Sodus, where a large number of subscribers have been received. The line will be extended through to Oswego without delay. Twenty miles of line will make the connection, as the system extends 20 miles west of that city at present. Oswego is now reached via Syracuse.

The subscribers, of the Shortsville, N. Y., Telephone Company will soon have direct communication with Canandaigua, as an arrangement has been made between the Red Jacket Telephone Company and the Inter-Ocean Company, which permits the latter company to string two pair of wires upon the poles belonging to the former company from Shortsville to Wadsworth's Corners, in the town of Hopewell, at which point the Inter-Ocean will occupy the poles of the Lawson to Canandaigua.

The Tri-State Telephone Company has connected up its through line from Connellsville, Pa., to Wheeling, W. Va. At the latter place the line connects with the National Telephone Company. The circuit now connects with the towns of Fairmont, Morgantown, Clarksburg and Mannington, and numerous other smaller towns. Going westward the connections have been made with Steubenville and St. Clairsville.

H. H. Yard was lately granted a franchise to build a telephone or telegraph line along the public roads of Plumas County, Cal.

The Madison, N. Y., Mutual Telephone Company has been incorporated with $1,500 capital stock.

The Battle Creek, Mich., Telephone Company has decided to install the automatic system.

Telephone Incorporations.

The Citizens' Telephone Company, Zionsville, Ind. Capital stock, $15,000. Officers. President, James O. Hurst; secretary and treasurer, H. F. Gallimore.

The Hollansburg Home Telephone Company, Hollansburg, O. Capital stock, $10,000. Incorporators: G. W. Harley, S. V. McKesel, G. U. Wolf, W. A. Chenoweth, C. A. Brown and J. E. Irelan

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alhambra, Cal.—Bids for an electric light and power franchise for this city will be opened by the trustees February 9.

Bay City, Mich.—April 4 the electors of the city will vote upon a proposition to bond the city for $50,000, in order that money may be obtained to defray the expenses to making additions to the city's electric lighting plant.

Black River Falls, Wis.—The special election held here recently to vote on the question of bonding the city for $25,000, to purchase the electric light plant, was carried.

Braddock, Pa.—A committee has been appointed to consider the practicability and cost of a municipal electric light plant.

Catorce, Mex.—An electric light plant is to be installed at the Delores Trompeta Mine, situated in this district.

Cicero, Ind.—A new electric light plant will be erected here.

Coeymans, N. Y.—C. M. Tompkins is at the head of a movement by the citizens asking the town board to establish on electric lighting system in the district.

Guthrie, Okla.—A plan is on foot to enlarge and improve the Guthrie electric light plant.

Index, Wash.—F. G. Dorety, backed by San Francisco and New York capitalists, says he intends to build a light and power plant near here.

Irvington, N. J.—A proposition has been made to the council offering to light this town for $9 a lamp, the town to furnish the system. William L. Gloreiux may be able to furnish information.

Jacksonville, Fla.—Negotiations are reported under way for the purchase of the electric light plant of the Jacksonville Electric Company.

Kirkwood, Ill.—J. F. White and Dr. Kyler propose to put in a heating and electric light plant here to cost $8,000.

Millen, Ga.—This city is still negotiating with R. E. Riley, who owns an interest in the Millen cotton mill, to establish an electric light plant here.

Monticello, Wis.—An electric light plant is one of the possibilities of this city.

Negaunee, Mich.—All bids are reported as rejected for new electrical machinery for the municipal electric lighting plant. New specifications are to be drawn and new bids invited, according to reports. John Davey is city engineer.

Plainfield, Ill.—The village board at its next meeting will take up the electric light proposition.

Santiago, Cuba.—It is stated that Eduardo J. Chibas, who is the engineer for the proposed electric plant and tramway here, will probably let the contracts in about two months for the electric light plant. There will be 8,000 16 cp. incandescent and 100 1,200 cp. arc lights, and the plant will cost about $200,000. The commencement of work depends upon the city awarding to Mr. Chibas a contract for the lighting of the city, terms for which are now being considered.

St. Joseph, Mich.—It is reported that the proprietors of Higham Park contemplate placing an electric lighting plant in the park.

Tallahassee, Fla.—Bonds to the amount of $40,000 will be issued for sewerage purposes, also bonds for electric light purposes.

Warrensburg, Ill.—There is some talk of establishing an electric light plant in this village.

Wilkes-Barre, Pa.—A meeting will be held here soon for the purpose of considering the advisability of granting a franchise to the Ashley Electric Light & Power Company.

Waterville, Wash.—The city council has entered into a 15-year contract with George H. Gray & Son, of Entiat, to furnish electric light and power to the city at $50 per horse power per annum, the city to use 50 hp. or more. The plant is to be in operation by September.

STREET RAILWAYS.

Appleton, Wis.—The Outagamie Traction Company has been incorporated to build and operate an electric railway with a capital stock of $30.000. The directors are A. Hawes, Thomas L. Pearson and others.

Belleville, Ill.—The Belleville council has granted a franchise to the Southern Illinois Electric Railway Company to operate an electric line.

Benton Harbor, Mich.—J. G. McMichael, the street railway promoter, was recently given a franchise for a new electric road from this city to Dowagiac.

Colfax, Wash.—The Whitman Railway & Power Company has been incorporated with a capital of $500,000. The company will build an electric road from Palous to this city.

Deerfield, Mich.—An effort is being made to obtain right of way from Britton through this place for an electric railway to connect with the Toledo line at Petersburg. A double track is to be laid and everything completed by summer.

Defiance, O.—A company headed by several local men, combined with the officials of the Toledo-Indiana Electric Railway, has been formed to build a line from this city to Adrian, Mich. Peter Kettenring, head of the Defiance Machine Works, is interested.

Elizabeth, N. J.—The Morgan County Traction Company has applied for a franchise in the township of Union.

Mechanic Falls, Me.—An electric road will be built between here and Lewiston.

Norfolk, Va.—A company has been chartered here to build an electric railway to Elizabeth City, N. C.

Odessa, Del.—There is some talk of a trolley line from Stanton to this place, running through to St. Georges. The object is to connect Stanton, which is the terminus of one of the suburban lines of the Wilmington City Railway Company, with Odessa.

Rochester, N. Y.—This city gives promise of becoming a great terminal for electric railways. No less than four more trolley roads to run to this city are planned. These are the Ridge Road Railway, which will connect with the Lake avenue tracks of the Rochester Railway Company; the Williamsville & Buffalo Railroad, which has laid tracks to Batavia; the Rochester, Syracuse & Eastern Railway, which will enter the city via University avenue, and the Albion Electric Railway, which is to connect with the Lyell avenue tracks of the Rochester Railway Company.

Russellville, Ky.—J. R. Reynolds, of this city, represents the Southern Kentucky Interurban Traction & Power Company, which is incorporated under the laws of New Jersey. He is procuring rights of way from here along the Russellville and Gallatin highway via Middleton and Sulphur Springs to Franklin. The object is to build an electric rail line from here to Franklin He pays $100 for each grant, and guarantees that if work is not under full headway in one year the lands revert to the venders.

San Jose, Cal.—Sealed bids will be received by Joseph A. Belloli, Jr., city clerk, up to 3 P.M. February 15, for a franchise to construct and operate an electric railroad over certain streets in this city for a period of 50 years.

Salem, O.—The Stark Electric Railway Company was lately granted a franchise through this city.

Seymour, Ind.—Col. A. E. Boone is planning a new electric railway line.

Spokane, Wash.—A. J. Smith, Samuel J. Crutcher and A. H. Gaston, of Pine City, will build an electric line from this city to Colfax.

Tacoma, Wash.—The Northern Pacific Railroad Company, after operating its South Tacoma car shops for years with steam, has decided to introduce electricity as a motive power. The change will be made some time before May 1.

Toledo, O.—The Lake Erie & Southern Traction Company is the name of a company recently incorporated to construct an electric railway line from this city to Columbus.

Utica, N. Y.—Paul Smith, the veteran Adirondack hotel man, is authority for the statement that next summer will see the beginning of construction work on an extensive system of electric roads in the north woods. The power for the proposed road will be taken from Franklin Falls in the Saranac River, 20 miles away. It is understood that the plans provide for the connection of Saranac Lake with all the villages thereabouts, as well as with this city.

Wabash, Ind.—G. A. Bartholomew, L. A. Smartt and the Municipal Bond & Securities Company of Cincinnati, are interested in the proposed traction company from this city to Rochester.

Watsonville, Cal.—W. J. Rogers has applied for a franchise to construct and operate an electric railway over certain streets in this city. Bids for said franchise will be received up to 8 P.M., February 17. S. W. Coffman, city clerk.

West Newton, Pa.—The Monongahela Traction Company is making preparations for the building of its lines from here to Jeannette.

POWER PLANTS.

Denver, Col.—The F. M. Davis Iron Works, builders of mining and milling machinery, propose installing a new electric power plant during this year at an approximate outlay of $25,000.

Westcliffe, Col.—The Bassick Company has under consideration the construction of an electric power plant on Grape Creek, near here, to furnish power for its machinery.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅜@12½c.; Lake 12½@12⅝c.; casting, 12¼@12⅜c.

There was a bear raid on Brooklyn Rapid Transit on Monday, based upon rumors of a new large bond issue.

Prominent New York capitalists have become identified with the United Electric Light & Power Company of Baltimore.

By agreement of both parties to the Chicago Union Traction suit, arguments will be heard by Judge Grosscup on March 1.

It is claimed that the Westinghouse Company's annual report will show an accumulated surplus of about 62 per cent. of its capital stock.

The New England Telephone & Telegraph Company has declared the regular quarterly dividend of $1.50 per share, payable February 15.

The fiscal year of the General Electric Company ended on Saturday. The total sales for the year are reported to have exceeded $40,000,000.

The market for copper on Monday was again inclined to weakness under a further reduction of ¼c. per pound in all grades. There was little demand for home consumption.

Announcement has been made that arrangements have been concluded for the building of a third-rail street car system between Elmira and Corning, N. Y., by Mansfield & Powers of Troy.

W. C. McMillan of the Union Trust Company of Detroit will be chairman of the board of the reorganized Michigan Telephone Company. The new company will be financed for $10,000,000.

The Twin City Rapid Transit Company has declared a regular quarterly dividend of 1¼ per cent. on the common stock, payable February 3. Books close to-day and reopen February 16.

Eastern capitalists have purchased the property of the Lawrence Telephone Company, having exchanges at Ironton, O., Ashland, Catlettsburg, Russell and Rush, Ky., and minor points.

It has been learned from thoroughly trustworthy sources that at least two directors of the Metropolitan Elevated Company of Chicago have signified their intention of resigning unless the agitation against the management ceases.

The Columbus Public Service Company, with an authorized capital of $1,500,000, has been incorporated at Trenton, N. J., to make and distribute heat, light and power. The incorporators are Horace S. Gould and H. O. Coughlan, of New York; Joseph M. Mitchell, of Newark; B. S. Lantz, of Brooklyn, and Louis B. Dailey, of Jersey City.

A. E. Appleyard & Co. of Boston have completed arrangements for the consolidation of four of their electric lines in Ohio under the name of the Ohio Union Traction Company. These four companies operate 200 miles of track and have a total capital of $5,000,000. Five per cent. bonds will be issued to take up $3,250,000 of preferred stock.

The Massachusetts Railroad Commissioners have given their approval to the sale of the Framingham, Southboro & Marlboro Street Railway Company to the Boston & Worcester Street Railway Company and have authorized the latter company to issue 1,850 new shares to consummate the sale, the said new shares to be exchanged share for share for the capital stock of the Framingham, Southboro & Marlboro Street Railway.

ELECTRIOAL STOCK QUOTATIONS.

Name.	Closing price Feb. 1.
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	143½
Metropolitan Street Railway	120½
Metropolitan Securities	87
Ninth Avenue	200
Third Avenue	120½
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	46¼
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	269
Philadelphia.	
Consolidated Traction of New Jersey	64
Philadelphia Traction	97⅝
Union Traction, $17.50 paid	47½
Boston.	
Boston Elevated, full paid	140
West End Street, com	91
do. do. do. pref	110
Chicago.	
City Railway	165
North Chicago	87
Union Traction, com	5¾
do. do. pref	30½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	22
do. do. pref	52
Electric Lead Reduction	⅞
Electric Vehicle, com	11
do. do. pref	15
Westinghouse, com	166
do. pref	192
General Electric	169½
Boston.	
Edison Electric Illuminating	235
General Electric	170
Massachusetts Electric Companies, com	23½
do. do. do. pref	79
Westinghouse Electric & Mfg., com	83½
do. do. do. pref	92
Chicago.	
Chicago Edison	149
National Carbon, com	28
do. do. pref	96
Philadelphia.	
Electric Company of America	8⅛
Electric Storage Battery, com	60
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	127½
Western Telephone Company	11
New England Telephone Company	2½
New York.	
American Telegraph & Cable Company	86½
Commercial Cable Company	180
Mexican Telephone Company	2
New York & New Jersey Telephone Company	140
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88¼
Miscellaneous.	
Chicago Telephone Company	90
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	27½
Consolidated Car Heating	66
Standard Underground Cable	200

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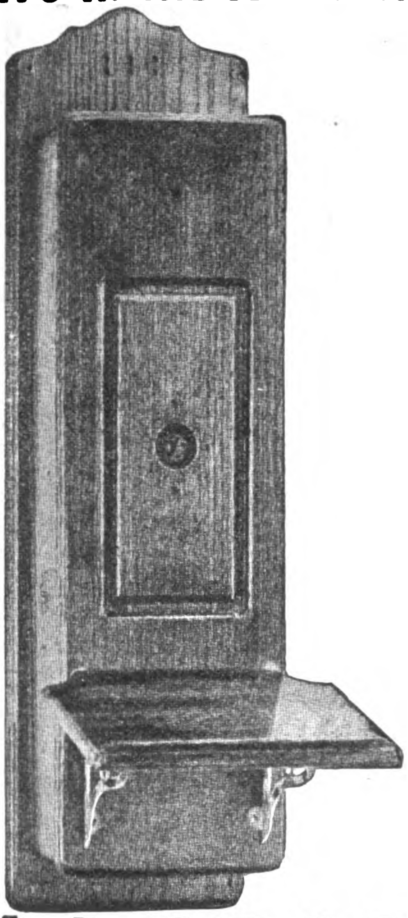

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Our Specialty is

High Grade Finish and Accurate Work.

These two cuts show our new Compact Cabinet with nickel-plated brackets supporting the paper shelf. The paper shelf and nickel-plated brackets are removed in shipping. Doing this saves room, avoids scratching, and facilitates shipping.

The nickle-plated brackets make a handsome contrast with the highly finished quarter-sawed oak front and paper shelf.

We Can Furnish These Cabinets All Drilled Ready for the Working Parts.

In addition to the above cabinet, we make all of the standard styles including

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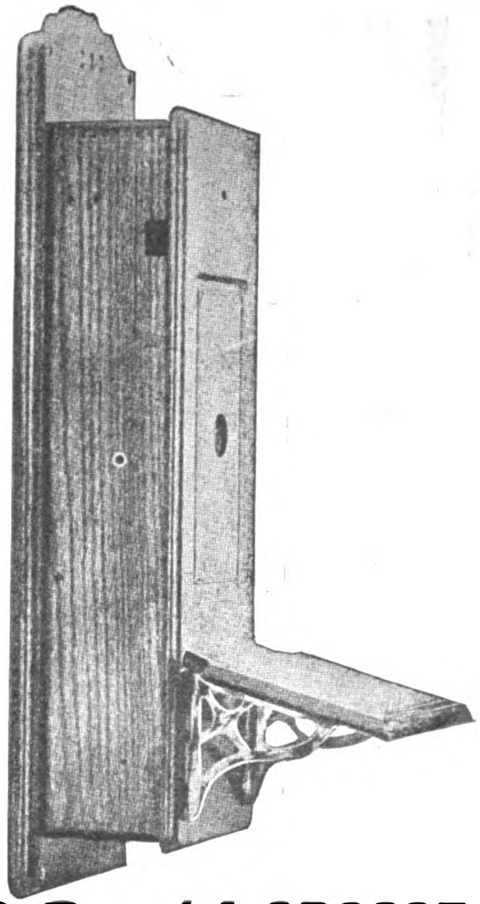

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CONTENTS.

EDITORIAL NOTES.

Was it the Man or the Machine? The fall of an electrically operated elevator last week in a nineteen story Broadway office building, situated on the lower part of Manhattan Island, again brings up the question as to where the blame lies—with the man or the machine?

Fortunately the elevator only fell from the fifth floor, which, however, resulted in five persons being more or less seriously injured.

Naturally the elevator company will claim the operator was to blame, and the fact that it was the man's first day on that type of elevator would seem at first glance to bear out the company's assertion. On the other hand the man was what might be termed an experienced operator, having run various types of elevators for twelve years.

The type of electric elevator that fell requires, if all the mechanism is in working order, but three motions of a hand lever to cause it to ascend, stop and descend. When the lever is upright brakes are supposed to hold the car so that it cannot move. An experienced elevator man ought therefore to have little or no trouble in operating such an elevator even for the first time, providing, as already stated, all the mechanism is in good working order. A new operator would probably not be able at first to make the stops at the various floors as nicely as an experienced hand, but it is hard to see how if everything is in order he could cause it to fall five stories when the simple act of bringing the lever upright should stop the car.

We think that a thorough investigation will reveal the fact that the machinery was not in good working order.

But whether the operator was to blame or not it is in place to say a few words about elevator men in general. In 1898 the city compelled elevator men to be examined. It is true the examination left much to be desired, but the moral effect was good. An elevator man before going before the board *generally* took the trouble to study up the working of his elevator to a greater or less extent, which did him no harm. A large number of so-called elevator men, operating lifts in this city at the present time, are nothing more than boys, who have no more idea as to what would happen or what does happen if they yank the elevator rope hard than an unborn child. It is about time the city held another examination for elevator men, and it is to be hoped that the questions asked will be of more vital importance than those asked six years ago.

* * *

Electricity in the Navy. Some interesting facts are contained in the report of Lieut. Harry George, U. S. Navy, inspector of electrical appliances. Among other things it is shown that the sum of $376,964 was expended during the last fiscal year upon the installation and repair of electrical appliances on shipboard, and $212,836 on the manufacture and repair of electrical apparatus and appliances in navy yard shops. Alterations, additions and repairs to the electrical appliances of 119 naval vessels were made during the past year.

A portable searchlight has been designed for use in connection with coast-defense districts and the occupation of advanced naval bases. In general, the apparatus consists of two units, each mounted on broad threadwheels, suitable for operation in a rough country, and so constructed that it can be readily assembled or disassembled for transportation in ships' boats.

During the past year the Bureau of

Equipment of the Navy Department has acquired two sets of the Ducretet loud-speaking telephone, marine type, extensively used in the French Navy. This apparatus, together with a set of the Graham instruments, English Navy type, will be tested in competition with the Bell and other instruments of American manufacture and installed on board ship for further observation.

A new system of battery fire control has been designed during the year to meet the requirements of the Bureau of Ordnance. In this system the guns are divided into groups instead of by divisions, as heretofore, each group including all guns of practically the same nature and having the same arc of fire. The system possesses great flexibility and enables separate and distinct orders to be transmitted simultaneously to the various groups of guns.

The school at the New York Navy Yard for the instruction of enlisted men for the rate of electricians, with a view of detail on shipboard as dynamo tenders and for the care of electrical appliances, has been successfully conducted during the past year. It will soon be moved into more suitable quarters, with additional appliances, where it is anticipated it will be still more efficient.

* * *

Safety Device for the Park Avenue Tunnel.

That there shall be no more loss of life through fire in the Park Avenue tunnel of the New York Central Railroad is the intention of the management as well as of the State Railroad Commission. With a view to introducing proper safeguards a careful inspection of the tunnel has recently been made by Fire Chief Kruger and one of the State Railroad Commissioners. They plan to install whatever apparatus may be necessary to quickly extinguish any blaze that may arise, especial provision being made for the coming electrical operation of the road.

Referring to the matter one of the gentlemen is reported as saying that the plans now being prepared are designed not only to insure safety from fire so far as possible after the new system of electric traction shall have been installed in the tunnel, but to improve the situation even under existing conditions,

As we suggested some time ago in these columns in reference to the new subway, it might be a good idea to install in the Park avenue tunnel a system of overhead sprinklers which could immediately be turned on in the event of a collision and the cars taking fire.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Columbia, Harvard and Yale Universities and the Massachusetts Institute of Technology have reached an agreement by which a Western mine will be leased for the benefit of students of mining.

Messrs. Otto Blathy, Max Dery and Prof. Charles Zipernowsky have been elected members of honor of the Hungarian Society of Buda-Pest, in token of their distinguished services to electricity.

At a dinner given Friday evening by the Technology Club of this city, composed of the alumni of the Massachusetts Institute of Technology, the members indulged in "liquid sunshine," but none of the self-sacrificing scientists who drank the liquid became transparent afterward, although all were assured that, as a matter of fact, their interiors were thoroughly illuminated. A demonstration was afterwards given of the luminous effect of radium on willimite, kunzite and other minerals. Addresses were made by President Pritchett, Dr. Morton and Dr. Savage.

Two hundred all-metal cars have been ordered by the Interborough Rapid Transit Company for operation in the New York subway and they will be ready for use in March. It is said that these are the first all-steel cars ever built in the world, and the company asserts they assure the traveling public absolute safety from fire.

Dr. George F. Kunz of New York, special agent of the United States Geological Survey, has been appointed commissioner of the radium exhibit at the St. Louis Exposition, and has been authorized to prepare and procure material therefor, comprising radio-active substances of all kinds, and also exhibits to illustrate the action of radium compounds, ultra-violet light, and Roentgen rays upon mineral and chemical substances.

At the American Institute dinner tomorrow night at the Waldorf-Astoria, of which Thos. A. Edison will be the guest of honor, one end of the Commercial Cable Company's cable will be taken into the grand ball-room of the hotel, and will be connected to the table at which the inventor will sit. By means of the old quadruplex instrument which Mr. Edison used many years ago when he was a telegraph operator, and which has been in the museum of the Western Union Telegraph Company for a long time, he will send a message across the ocean to Marconi, who will try by means of some new instruments to reply across the ocean by the wireless method. Messages to all of the great scientists in both America and Europe will be sent from the room where the dinner will be held.

Rear-Admiral Melville, U. S. N., has been sent to Europe to study steam-turbine machinery, particularly for use in the new 4,000 ton scout ships of the navy.

A cable dispatch received from Prof. Michael Pupin of Columbia University, who is now in Berlin, announces his complete victory over the German postal administration on the contest to establish his patents of long distance and ocean telephone devices. The American rights to the invention have been sold to the American Bell Telephone Company, and Prof. Pupin made arrangements for the sale of the foreign rights to the firm of Siemens & Halske of Berlin in the event that he could establish his patents. A contest was joined in German courts by several private concerns and has been waged for four years.

The Western Union Telegraph Company is said to receive over $1,000,000 a year for keeping 70,000 clocks going on correct time. The clocks are set at noon each day by an automatic arrangement connected with the great sidereal clock in the National Observatory at Washington. A few minutes before noon every day business over the Western Union wires is suspended, and operators through the country put their instruments in shape to form an unbroken circuit from the obsertory to every place where ticks a clock to be electrically influenced. There is a hush over all the great telegraphic system Then the time ball strikes; and instantly the time message flashes over the wires.

A series of tests of four systems of wireless telegraphy will soon be made by warships in this vicinity. The progress of wireless telegraphy in the navy recently has been very satisfactory. In one case the flagship Kearsarge and the Minneapolis communicated with each other by the wireless method at a distance of 60 miles.

Plans are being made in automobile circles for the largest and longest endurance run ever held in this country. In connection with the endurance run itself, it is also hoped to hold a series of club runs, all to have St. Louis for their goal.

SPEED-TORQUE CHARACTERISTICS OF THE SINGLE-PHASE REPULSION MOTOR.*

BY WALTER I. SLICHTER.

The single-phase commutator motor has attracted considerable attention of late, as there is quite a demand in railway work as well as in numerous other lines for an alternating current motor that will start under a heavy load with a reasonable consumption of energy. At present it appears that a commutator motor is the only type that will fulfill these conditions.

For some months past the writer of this paper has been in charge of a series of experiments with various types of alternating current commutator motors. During these experiments much attention was given to the repulsion motor. It is the purpose of this paper to place before the Institute some of the results obtained, and to point out some of the characteristics of the motor which give future promise of making it a very prominent factor in some lines of electric railroading.

For the benefit of those not already familiar with this type of motor, it may be here stated that it is a single-phase commutating motor, resembling very much a regular direct current armature in an induction motor field. The resemblance to the induction motor is carried still further in that there is no electrical connection between the primary and secondary. This makes it possible to wind the primary for a high line voltage, while the voltage of the secondary winding is chosen at such a value as may be commutated satisfactorily, since it is short circuited on itself through its brushes.

The motor has the same characteristics as the direct current series motor, namely, maximum torque at starting, increasing torque with increasing current and decreasing speed, and comparatively constant efficiency through a wide range of speed. The maximum speed of the motor is limited only by the load and impressed voltage and has no relation to the synchronous speed.

Due to the reactance of the motor circuits, the power-factor at starting is low and will be with any alternating current motor; but in the repulsion motor a low power-factor does not mean small torque. On the contrary, the maximum torque occurs simultaneously with the lowest power-factor; that is, at starting. The power-factor of the repulsion motor rises very rapidly with the speed; it reaches a good value at one-third synchronous speed, and values near to 90 per cent. are obtained over a considerable range of speed. For this reason a large number of poles is not necessary and frequencies of 25, 40, and even 60 cycles may be employed.

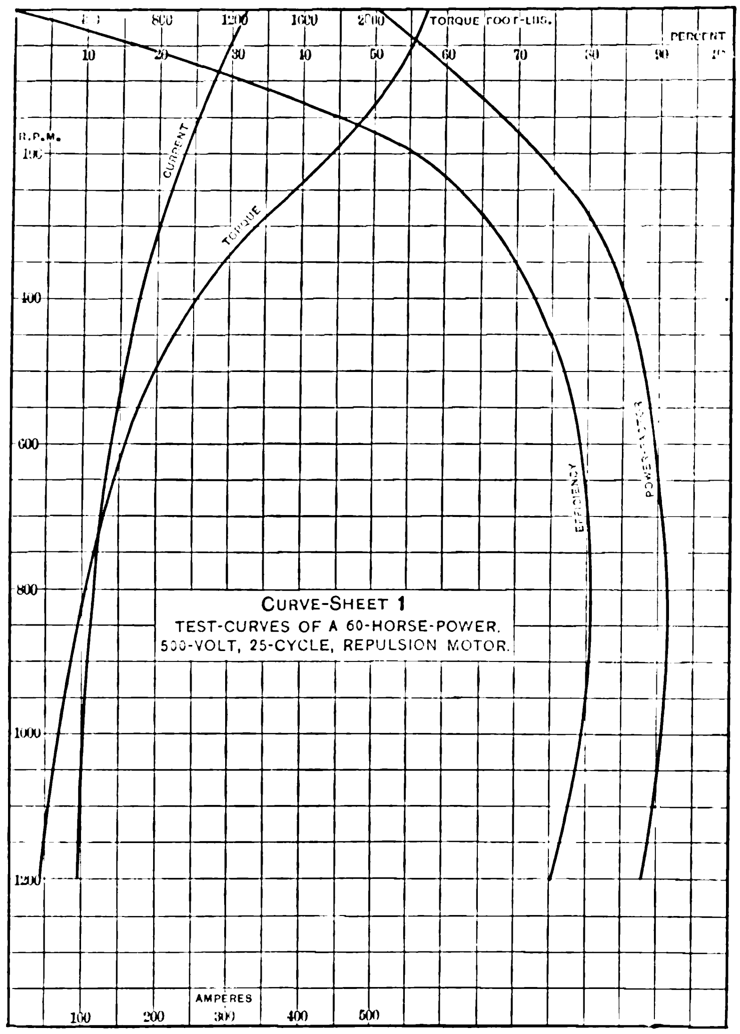
The rotating conductors of the secondary cutting the primary flux, generate a leading EMF., which causes a leading current to flow therein and gives the high power-factor of the motor. In the plain repulsion motor, this leading current never reaches a value great enough to compensate entirely for the magnetizing and other wattless currents at available speeds, but the phenomenon is utilized to obtain unity power-factor in the compensated type by the addition of a second circuit. The inherently good power-factor of the repulsion motor makes it possible to use larger clearance between field and armature than is permitted in induction motors, thus greatly increasing its value in railway work where comparatively large air-gaps are necessary.

The curves given are partly from test and partly from calculation of motors having air-gaps on a side of ⅛ inch and more. The air-gap of corresponding stationary induction motors would be .040 inch and more.

The efficiency, while not so good as in a direct-current motor, is yet very good, reaching values of from 80 to 85, including gear-loss for sizes ranging from 50 to 200 hp.

Commutation at normal speeds is inherently good, due to the revolving field. As the speed decreases, the current increases rapidly, producing a tendency to spark, but with the reduced voltage of starting the rush of current is limited to values within the range of good commutation, as in the direct-current motor.

At higher speeds, ranging above one-and-a-half times synchronism, the frequency of commutation becomes high and sparking appears.



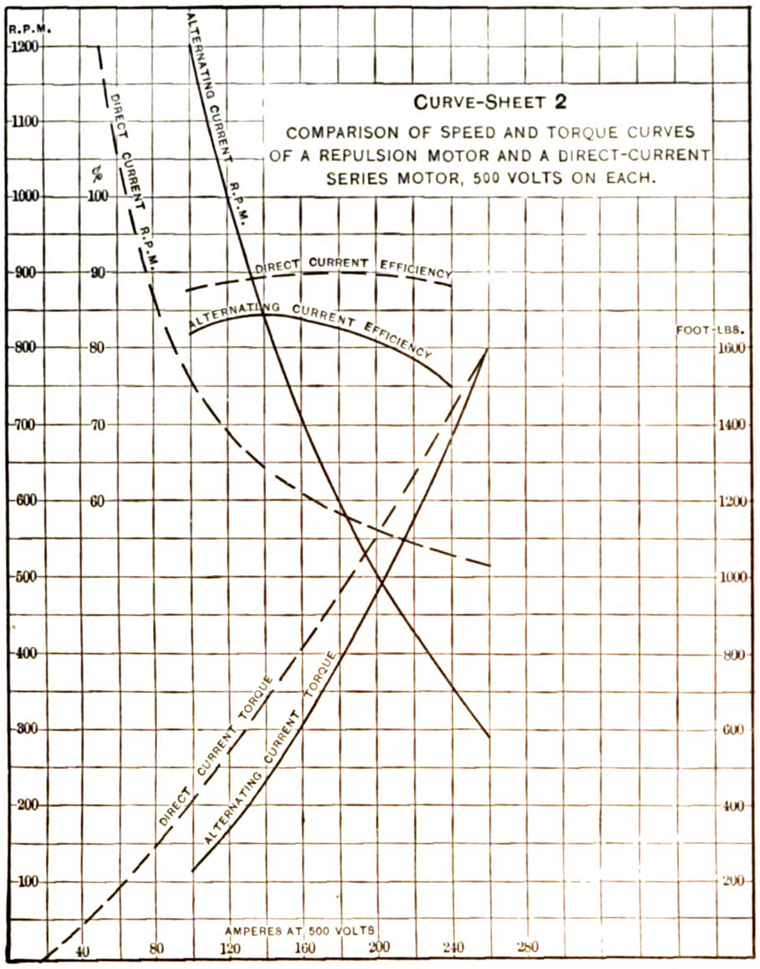
CURVE-SHEET 1
TEST-CURVES OF A 60-HORSE-POWER. 500-VOLT, 25-CYCLE, REPULSION MOTOR.

The motor of Curve-Sheet 1 will start with 75 per cent. of full voltage and twice full-load current with no trouble from sparking. As these curves are prepared upon a railway-motor basis and full-load current will produce a rise of 75 degrees C. after one hour's run the ability of the repulsion motor successfully to commutate over-loads is equal to that of the direct-current series motor, in fact, better, due to the short-circuited commutator, which makes flashing-over impossible.

Curve-Sheet 1 shows the characteristics of a repulsion motor plotted with

*Paper read at the 183d meeting of the American Institute of Electrical Engineers, New York, January 29, 1904.

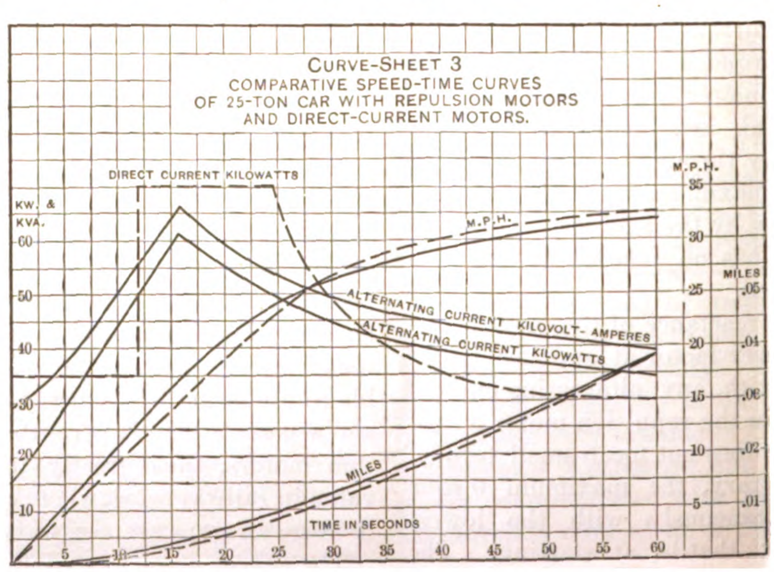
revolutions per minute as a base. The curves shown are taken from tests on a 60 hp., 25 cycle, 500-volt motor; they show the rapidly rising efficiency and



power-factor and the large torque at starting. The starting torque is 2,300 foot pounds, with an input of 325 amperes, and the normal torque during acceleration is 450 foot pounds at 750 revolutions and 125 amperes. Thus the starting torque is five times normal and the starting current 2.6 times normal, or the torque per ampere at starting is 1.92 times what it is at normal speed, should occasion demand the full starting capacity of the motor.

This gives an idea of the steep speed-characteristics of the motor, which are even better shown in Curve-Sheet 2. The full lines refer to a later type of repulsion motor and the broken lines to a standard direct-current series railway motor; these curves are plotted in the usual way with current as a base. This shows that the torque increases more rapidly with increasing current in the repulsion motor than in the series; and conversely that the speed of the repulsion motor increases more rapidly with decreasing current than in the series motor. Efficiency, including gear-loss, is given and is 84.5 per cent. at the maximum for the alternating-current motor. This motor was designed with the steep speed-characteristics for acceleration work, while the motor of Curve-Sheet 4 is designed for constant-speed running and has not such steep curves but better constants at light loads.

The characteristics show the repulsion motor to be admirably adapted for acceleration work, the efficiency of acceleration being higher than in direct-current work, due to the possibility of obtaining fractional E.M.F.'s with alternating cur-



rents without introducing the dead resistance losses of the direct-current system of control.

This is shown in the curves on Curve-Sheet 3, which gives the acceleration curves from a test of a 25-ton car equipped with two 60 hp. repulsion motors. The full lines indicate the repulsion motor characteristics and the broken lines those calculated for a direct-current equipment. The gearing is chosen for the same free running speed, 33 miles per hour, the same average acceleration, and the same distance covered in 60 seconds. For the direct-current motor the curve of kilowatts' input, miles per hour and miles traveled are given as calculated; and for the alternating-current motor the kilovolt-ampere input, kilowatt input, miles per hour and miles traveled, from test.

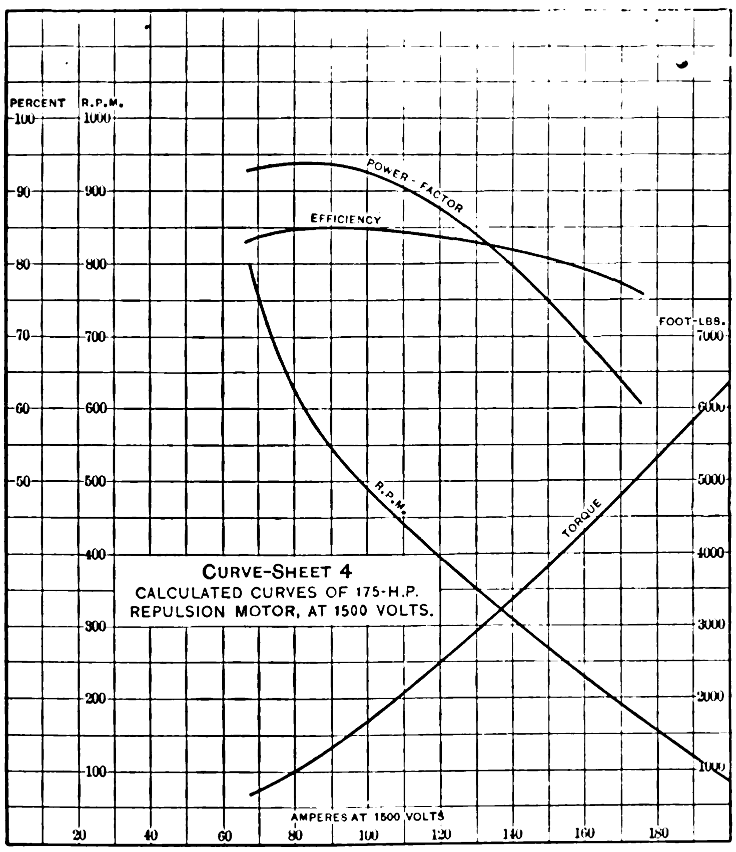
The repulsion motor remains on the controller only 16 seconds and the direct-current motor 25 seconds. The maximum power taken by the direct-current motor is 70 kw. and by the repulsion motor 61 kw. or 67 kilovolt-amperes. At the end of 25 seconds the total kw.-hour input in the two cases is .375 for the direct current and .30 for the alternating current. At the end of 60 seconds both cars have covered a distance of .039 mile and have reached practically the same speed of 32.5 miles per hour, the kw.-hour input being .72 for the direct current and .685 for the alternating current.

By comparing the areas of the kilowatt curves in the two cases the gain or rather the saving by the use of the alternating current is readily seen. It is also worthy of note that the volt-ampere input of the alternating-current motor is least at starting, that is, the line current is least. As this is the time at which the power-factor is lowest, it is seen that the effect of the low power-factor on the regulation of the system is much modified by the small value of the current. Curve-Sheet 4 shows the calculated characteristics of a 175 hp. railway repulsion motor having an air-gap of .15 inch and wound for 1,500 volts and 25 cycles. The

efficiency, including gear-loss, is 85 per cent. at the maximum and the power-factor is 93. Such a motor is designed for heavy, slow-speed locomotive work, which is probably one of the most promising fields for the alternating-current motor. It is readily seen how well it is adapted for freight haulage by the fact that the efficiency of 85 per cent. is attained at a speed as low as 500 revolutions, thus permitting a speed of 12 to 15 miles per hour with a good gear reduction.

Thus the repulsion motor is well adapted for acceleration work as well as for efficient running at light loads, and having good constants at low speeds is well adapted for freight haulage at low speeds.

The curves given in this paper all refer to the simple repulsion motor. There are many variations of the repulsion motor, more or less complicated, from which a better power-factor and even a better efficiency have been obtained in test. However, a description of these various schemes with their characteristics would require sufficient space to warrant a distinct paper and it is hoped to present such to the Institute at some future date.



CURVE-SHEET 4
CALCULATED CURVES OF 175-H.P. REPULSION MOTOR, AT 1500 VOLTS.

Discovery has been made in the northern part of Emery County, Utah, of an immense deposit of rock which, it is said, contains a large quantity of radium. The deposit of this rock is located on a ranch, and can be traced to the surface for 3,000 feet.

TESTING LARGE ALTERNATORS.*

BY W. E. BURNAND.

The tests mainly required on alternators are for ascertaining the efficiency, regulation on unity and lower power-factors and for heating under load. Two general methods appear to be available for making these tests, firstly, by the rather barbarous method of loading up the machine with resistances, choking coils, etc.; or, secondly, by more scientific methods which may be said to have had their commencement with Hopkinson, in which the machine under test and other apparatus connected with it are supplied only with the amount of power lost in the system. Unfortunately the second method, as hitherto practiced, seldom gives results strictly comparable with what will occur in actual use, and though it may be said to be scientific, if by science is meant measurement, it is hardly so if this is qualified by saying measurement of the thing you want to measure. The first method, however, is so cumbersome and expensive that in the case of really large alternators it becomes quite impracticable and the machine either has to go untested or some modification of the second class made, and the results that will occur in use with the machine deduced therefrom.

When two machines of equal capacity are available, they may be coupled together and the Hopkinson test pure and simple carried out, the power-factor of the load being varied as desired by manipulation of the field strengths.

As a rule, however, two machines are seldom available, and recourse must then be had to opposing half (approximately) of the armature to the other half, and circulating current through the windings in the manner described by Mordey, Behrend and others. But the methods I have seen described have always been open to some great objection, such as, when the armature is the rotating part, putting great, unbalanced strains on the machine, causing vibration which in some cases endangers the integrity of the machine, and also, in the majority of cases, the armature reaction, and consequently the core losses and regulation observed are entirely unlike what will occur in actual use, and, therefore, vitiate the results obtained as tests for regulation, efficiency or heating under full load conditions.

It seems to the writer that these objections can be overcome in a simple manner by the following methods: First, as to the unbalanced strains in the machine; the cause of this will be readily understood by reference to the diagrams. Fig. 1 represents an eight-pole alternator, con-

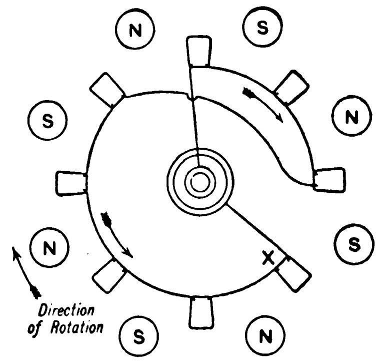


FIG. 1.

nected so that three coils oppose the other five. Connected thus, the five coils circulate a current round the armature against the E.M.F. of the three coils, the strength of which can be regulated by the field strength or by means of a rheostat in circuit. Thus half (approximately) of the armature will oppose the rotation of the machine, and the weaker half will help it, the difference in rotative effort plus friction having to be supplied from an external source. The arrows in Fig. 1 show the direction of this effort exerted by the two sides of the armature, from which it will be seen that both tend to force the armature in the same direction. If the armature is stationary, this is not usually of any great consequence, but if the armature is rotating, the effect is just the same as if a heavy weight were located at the point marked x, which naturally tends to put severe strains on the framework of

*From the "Electrician," London.

the machine. This could be balanced by a weight on the opposite side, the value of which could be calculated from the apparent horse power of the machine, the peripheral speed, diameter and power-factor, but a much better way would be to prevent these strains altogether, by dividing the armature circuit into quarters instead of halves, as shown in Fig. 2, coupling A and C in series, opposed to B and D. By this means the stresses, which are indicated in the figure by arrows, balance themselves round the circumference of the armature, leaving no unbalanced strains to be transmitted through the shaft to the framework of the machine.

Having got over this difficulty, there still remains that of armature reaction. The difficulty here results almost entirely from the great lag or low power-factor of the currents circulating round the armature, when the current is caused to circulate by a higher EMF. in one-half of the armature than in the other half. Thus the current in the coils is nearly at its maximum when they are directly opposite the pole pieces of the machine, whilst with a power-factor of unity the current is zero in this position, the conditions being reversed again in the midway position—i.e., the lagging currents are nearly zero here, whilst the current with unity of power-factor should be at its maximum. It is evident that this must have a great effect on any test for regulation or efficiency, the 1. power-factor having comparatively little influence on the poles, whilst with currents lagging nearly 90 degrees the coils on the weaker half, or the half in which the current flows against the induced EMF., have a powerful tendency to help the magnetic field, and on the stronger half a powerful demagnetizing tendency, thus giving rise to induced currents in the magnetic system, and also affecting the core losses of the machine. The mechanical strains also are not those met with in use—there is more tendency to vibration, and less of a straight pull or push backwards on the coils than is the case under load, when the current through the coils is at a maximum at the point midway between the poles—hence in a position of maximum effect.

The effect this has with a current lagging about 90 degrees is that for every time a coil passes a pole piece, it is first subjected to a force in a backward direction till it gets opposite the pole, and then in a forward direction till in the midway position. Thus there is a severe racking strain backwards and forward at the rate of four times the frequency of the machine, whereas with a current in phase with the EMF. the strain is always in one direction, either backward or forward, considered with respect to the direction of rotation, according as the current circulates with or against the EMF.

The method devised by the writer to overcome these difficulties is to connect up the armature as in Fig. 2, the number

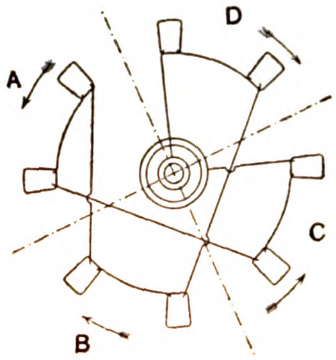


Fig. 2.

of coils in the quarters A and C being equal to that of B and D, so that the EMF. of two quarters opposes and balances the EMF. of the other two quarters, and to circulate an alternating current through the armature from an external source of the same frequency as the machine under test, and whose phase with respect to this machine may be readily adjusted. This external source may consist of a small alternator with the same number of poles as the machine under test and coupled to the same shaft, or it may be a machine of a different number of poles, driven from the shaft through chain or spur gearing. This machine, of course, may be in circuit with the large one, either direct or through a transformer, and only need be of a size capable of supplying the electrical losses in the large generator and con-

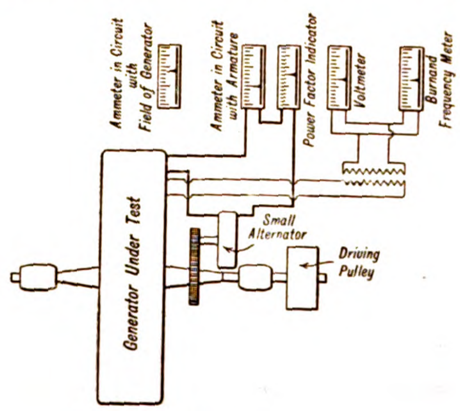


Fig. 3.

nections. By this arrangement practically all the effects of full load can be simulated in a manner to get practically reliable results. The auxiliary alternator can be so driven with relation to the machine under test as to circulate a current of leading, lagging or any desired power-factor.

The heating can, therefore, be determined for any of these conditions, and the regulation likewise. The efficiency can be determined from the balance of power required to drive the machine at its working speed with full load current circulating through the armature, at any desired power-factor, after subtracting the power lost in the outside connections, the auxiliary alternator and the gearing driving it, all of which can be easily determined with an accuracy near enough to give materially correct results for the machine under test.

Fig. 3 shows the manner of testing the regulation of the machine, the voltmeter and power-factor indicator being in connection with the half of the machine in which the current flows in the direction of the EMF., the frequency meter being connected at any convenient place, say, in parallel with the voltmeter. A reading is first taken with no current passing through the armature; afterwards a reading is taken with full-load current passing, the power-factor of which can be regulated by causing the auxiliary alternator to lead, lag, or keep in phase with the EMF. of the machine under test, the amperes being readily adjusted by a rheostat in the field of the small alternator.

Assuming the speed kept constant, the difference in the voltmeter readings gives the drop in half the armature. If the machine is designed to work with the armature coils all in series, the regulation is, of course, double this value; if the two halves are to be in parallel the regulation is direct as given by the voltmeter readings. Should it not be possible to get the speed quite the same as when unloaded, the effect of this can be calculated from the difference in frequency, the EMF. being proportional to this at constant excitation.

A variation of this method might be to have a voltmeter on each half of the armature, the difference in the reading with full-load current passing giving the regulation, but the first method is probably preferable for a generator, as the armature reactions in the half referred to more nearly approach those of practice than is the case in the other half of the machine, in which the current circulates against the EMF. as in a motor.

It would not do to take the ratio of the voltage required to circulate full-load current through the machine to the voltage of the machine under test as a measure of the regulation of the machine, since, as a rule, the EMF. of the auxiliary machine will not be in phase with the EMF. of the machine under test. As a somewhat exaggerated example might be cited the case of a machine requiring an EMF. in quadrature with its own—say of half its own value—to circulate full-load current through it, the current to be in phase

with the EMF. of the machine under test. The regulation in this case, instead of being 50 per cent., is actually about 10 per cent., as is readily apparent when attention is paid to the vector phase relations of the two EMF.'s and current.

ELECTRICAL STATION PRACTICE.

ARTICLE XXIII.

BY W. H. RADCLIFFE.

Electrical measuring instruments, owing to the nature of their construction and the conditions under which they must necessarily be used, are subject to variations in accuracy. This feature is an annoying one on account of the difficulty of detecting it; a meter may, as far as appearances go, be in excellent working order and yet give readings which are not to be relied upon.

Measuring instruments constructed for use on direct current circuits often suffer in this respect owing to a weakening of the permanent magnet used to establish a field for the movable fine wire coil, or again their readings may be inaccurate on account of the pointer being bent, and still another cause is the aging of the spiral springs attached to the top and bottom of the movable coil which renders them less capable of exerting the necessary tension. The last two mentioned defects are as common in alternating current instruments as in direct current instruments and produce the same inaccuracies in each. Owing to the difficulty previously mentioned of readily detecting a trouble of this nature, meters are often kept in service when their indications are practically worthless. Of course, in some instances in station practice where only approximate readings are desired, meters having inaccuracies of 3 or even 5 per cent. may be used. By "an inaccuracy of 3 or 5 per cent." is meant that the deflection of the pointer will be higher or lower than the exact value by an amount proportional to an error of 3 or 5 divisions in every 100 divisions; thus, a voltmeter showing a deflection of 103 volts across a circuit the exact pressure of which was 100 volts would be said to have an inaccuracy of 3 per cent. On the other hand, if it indicate but 97 volts, its inaccuracy would also be 3 per cent. For measurements of precision, or for observations in any class of station work upon which much confidence is to be placed or on which there is much at stake, instruments having inaccuracies as large as 3 or 5 per cent. should obviously not be used. Ridiculous as it may appear, the average station attendant may frequently be seen straining his eyes to read to tenths of a division on the scale of a meter which, if subjected to test, would show an inaccuracy of over 2 per cent.

To guard against such inconsistency, it is frequently necessary to compare the meters in use with standards. By "standards" are meant meters which are comparatively new and which have been the least exposed to harm or injury. The comparison is made in the case of a voltmeter by connecting it in multiple with a standard voltmeter across an adjustable resistance, which in turn is connected in the supply circuit. By varying this resistance the drop in pressure across it is altered and a means is thereby afforded of obtaining different readings on the voltmeters without changing their positions in circuit. Since the meter undergoing test is connected across the same part of the resistance as the standard meter, it is subjected to the same conditions and should if correct give the same deflections as those on the standard meter. It order to obtain the best results there should be one man at each meter so that simultaneous readings may be taken on both instruments, and the man at the standard meter should have control of the adjustable resistance.

Each meter should be checked or calibrated at five or six approximately equidistant points over its scale; the adjustable resistance being varied each time to give a deflection on the standard meter of an even number of divisions and the deflection on the other meter recorded at whatever it may be. Having obtained the necessary readings, the calculation of the constant or multiplying factor of the meter undergoing test is next in order. This may best be shown by taking an actual case in which a 150-scale voltmeter is being tested to determine its accuracy. The data and calculations are as follows:

Readings on Standard Meter.	Readings on Meter Tested.	Constant.
150	149.2	150 ÷ 149.2 = 1.005
125	125.0	125 ÷ 125.0 = 1,000
100	98.9	100 ÷ 98.9 = 1.011
75	73.6	75 ÷ 73.6 = 1.019
50	50.0	50 ÷ 50.0 = 1.00
25	24.8	25 ÷ 24.8 = 1.008
		6.043

Average constant for six readings, 6.043 ÷ 6 = 1.007.

It may be stated in general that before taking the readings for this test the zero position of the pointer on the meter tested should be noted, and if it be more than two-tenths of a division off the zero mark the case of the meter should be removed and the pointer straightened. Furthermore, it will be noticed from the readings here recorded that the test is started at the high reading end of the scale; this is done in order that the pointer may gradually be brought up to this spot, by slowly cutting out of circuit the adjustable resistance, and thus show whether or not the pointer has a tendency to stick at any part of the scale. If the meter seems to be defective in this respect, it should be remedied either by bending the pointer or scale, or by renewing one or both of the jewels, before the comparison with the standard is commenced.

It is obvious from the readings recorded for our 150-scale voltmeter, that as compared with the corresponding deflections of the standard, the former are a trifle low. In order to determine for each observation how much too low they are, it is necessary to divide each reading on the standard by the corresponding reading on the meter tested. The result is the amount by which a deflection of this size on the meter tested must be multiplied by in order to obtain the exact reading. This multiplier is called a constant, and as shown a constant is determined for each of the six observations. The average constant for the six readings is then found, and this is taken as the constant for the meter as a whole; that is, whenever this 150-scale voltmeter is used, each reading taken thereon must be multiplied by 1.007 in order to correct for its inaccuracy. The most convenient and systematic way of registering the constant of a meter is to write it, together with the number of the meter and the date of its calibration, in ink on a cardboard tag and loop the same by means of a string to the handle or some other convenient part of the meter. The tag may then be readily changed at the next test, as a new one will probably have to be made out when the meter is again calibrated owing to a change in the value of its constant.

The complete calibration of a two-scale voltmeter does not necessitate that the readings on both scales be checked with standards as might be supposed, for since the resistance corresponding to the one scale is always some multiple of the resistance of the other, the constants of the two scales are proportional. Suppose we let S = the reading at the end of the high scale of the voltmeter; s = the reading at the end of the low scale of the voltmeter; R = the resistance in the meter corresponding to the high scale; r the resistance in the meter corresponding to the low scale; K = the constant for the high scale, and k = the constant for the low scale. Then

$$\frac{S \times K}{R} = \frac{s \times k}{r},$$

from which $k = \frac{S K r}{s R}$. That is to say if the respective resistances corresponding to the two scales be known, and the constant of the high scale be determined by comparison with a standard, then by aid of these known values and the maximum readings on the two scales, the constant of the low scale, may be calculated. It is also possible to calculate the constant of the high scale if the constant of the low scale be known, together with the values of the resistances corresponding to the two scales, for from the equation previously given, $K = \frac{R s k}{r S}$.

The calibration of an ammeter for determining its constant should be conducted along the same lines as previously described for a voltmeter. The connection of the ammeter in circuit, however, would be different in that it would be joined in series with the standard ammeter and the adjustable resistance, instead of being wired in multiple with them.

If a voltmeter or ammeter upon being tested shows it to have an error of more than 1½ per cent., the use of a constant is not sufficiently accurate. It will be remembered that in the determination of the constant of a meter the average of six constants was taken. When the inaccuracy of the meter is not great this average value of the constant is sufficiently exact to be applied to all readings that may be taken on the instrument, but when the readings on the meter differ considerably from those on the standard it is advisable to construct a curve the abscissæ of which represent the values of the readings on the standard meter, and the ordinates of which represent the values of the readings on the meter tested. With this curve at hand, any measurement afterward taken on the meter may at once be corrected by locating a point on the curve directly opposite this reading as found on the vertical scale of ordinates, and then noting the reading on the horizontal scale of abscissæ directly below this point on the curve. The construction of a curve is recommended in place of a constant when the inaccuracy of a meter is 1½ per cent. or greater. The same number of observations as used for calculating a constant will be sufficient for determining the course of the curve. The test is therefore conducted in precisely the same manner as already explained. Usually, it is possible from the readings obtained in a calibration test to tell at a glance whether the inaccuracy of a given meter is greater or less than 1½ per cent.; if, however, there is any doubt in the matter, the constant should be calculated and the choice between this constant and a curve governed accordingly.

If the calibration of a meter shows an inaccuracy of 3 or 4 per cent., it is not advisable to use even a curve, unless as previously stated the meter is to be used for approximate measurements only.

The usual remedies to apply to a voltmeter in this condition, if it is afterward to be used for accurate work, consists in strengthening the permanent magnet, straightening the pointer, varying the tension of the spiral springs, renewing the jewels in the bearings, or altering the value of the high resistance contained within the case. Although these remedies are more or less simple and readily applied, it may be well to call attention to at least two of them, the strengthening of the permanent magnet and the altering of the value of the high resistance contained within the case. In order to strengthen the permanent magnet it is necessary to detach it from the base of the meter, wrap around it several turns of insulated wire, and pass through this wire for a short time 3 or 4 amperes of direct current in such a direction as to reinforce the magnetism the magnet possesses. In order to alter the value of the high resistance of the voltmeter it is necessary to first obtain the constant of the meter so as to know how many per cent. high or low it is on the average. The resistance in ohms of the voltmeter as a whole must then be measured, and a certain length of wire whose resistance in ohms is the aforementioned per cent. of the original resistance, must be either added to or taken from the resistance coil in the meter, depending upon whether its pointer gives deflections which are too high or too low. After applying any of these remedies, it is of course necessary to again calibrate the meter and give it a constant or curve before putting it in service.

The remedies to apply in the case of an ammeter which is 3 or 4 per cent. in error consists in straightening the pointer, varying the tension of the spiral springs, renewing the jewels in the bearings, and in the case of a direct current ammeter strengthening the permanent magnet and changing the number of auxiliary circuits between the two copper plates. In applying the last mentioned remedy, the number of the auxiliary circuits must be increased if the deflections are too high, and decreased if the deflections are too low.

The calibration of a portable wattmeter is accomplished with direct current of constant value which is passed through the series winding by connecting the source thereof with the current terminals. A direct current voltage which may be varied throughout the range of the wattmeter is also applied to the instrument between the middle and right-hand pressure terminals, the wiring in the meter between these terminals being such that its differential winding is then cut out of circuit. The method of procedure consists in comparing the deflections on the wattmeter at five or six approximately equidistant points over its scale with the corresponding products of volts and amperes used to obtain them. The changes in the wattmeter deflections are effected by merely varying the voltage, the value of the current being maintained constant at a value which represents the full current capacity of the meter.

The checking up of a recording wattmeter may conveniently be done by noting the deflections at short intervals on an ammeter connected in circuit, and also the reading on the dial of the recording wattmeter during this period. If this test is continued for an appreciable time, the product of the pressure in volts, the current in amperes, and the time in hours, should equal the number of watt-hours recorded on the counters of the dial.

In an alternating current meter one of the most frequent causes of error is the deterioration of its insulation which permits the working parts of the instrument coming in contact with the surrounding metal case. The most convenient method of testing a meter defective in this respect consists in connecting its terminals in series with a voltmeter in good working order and a source of voltage. Instead of connecting both terminals of the defective meter in circuit, however, but one terminal is thus connected, while the lead which would naturally be joined to the remaining terminal of this meter is brought in contact with its metal case. If there is a ground or contact between the working parts and the case, there will be a deflection of the pointer on the voltmeter. Suppose it be desired to have the insulation resistance of the defective meter measure R ohms. Then if the voltage at hand be V volts, and the resistance of the voltmeter in use be r ohms, the current, C, passing through the grounded part of the defective meter is $C = \frac{V}{R + r}$.

The pressure, E, necessary to force this current from the metal case of the defective meter to its working parts is C r, and as the values of both C and r are known, the value of E may be determined. If, therefore, the voltmeter in use shows a

deflection not lower than E volts under the conditions mentioned, the insulation resistance of the defective meter will be at least R ohms, and the fault evidently lies elsewhere. On the other hand, a deflection of less than E volts on the voltmeter in use will indicate a low insulation resistance in the meter tested, and an inspection of the interior wiring of this instrument will probably reveal the cause of the trouble.

RADIUM.*

BY PROF. R. A. MILLIKEN.

(*Concluded from page 67.*)

The study of the cathode rays has sounded the death knell of the indivisible atom of our earlier chemistry, and gave the first suggestions of the discoveries which were soon to follow, which showed that under some circumstances the atoms of chemistry do disintegrate into small parts.

It was first thought the X-rays were cathode rays after they got out through the walls of the tube, but they proved not to be so, because the X-rays are not deflected in the slightest degree by a magnet, not deflected by an electrostatic field, and do not impart negative charges to objects on which they strike; and they are supposed to be ethereal pulsations of the same nature as light, whereas cathode rays are streams of projected particles shot off from a negative electrode. At first the rays emitted by uranium were thought to be a form of X-rays. But it was found that rays from uranium were deflected as cathode rays, and also the rays would impart negative charges upon any objects upon which they struck; so we say that radio-active substances are always spontaneously emitting cathode rays.

In 1899 it was discovered that cathode rays are not the only particles to be shot off by radio-active substances. There are other particles which differ from the cathode particles, first in penetrating power, and second, these penetrating rays are deflected by the magnetic field. These are the cathode particles, whereas the non-penetrating rays will not produce photographs and are not deflected—they are not the same as cathode ray particles. The non-penetrating rays have been called the Alpha rays and the cathode rays the Beta rays. Prof. Rutherford showed that the Alpha rays, with a powerful magnet, are deflected to the right, while the Beta rays are deflected to the left. The Alpha rays are deflected not only by a magnet but by an electric charge, though in every case they were deflected much less than the Beta rays, but always in the direction in which they would be deflected if they consisted of positively charged particles.

These experiments have been confirmed, and we can say with positiveness that we know that the Beta rays consist of streams of negatively charged particles, and the Alpha rays of positively charged particles, but from the amount of deflection of the Alpha rays a very surprising result is obtained, namely, that the Alpha rays instead of being composed of minute particles of the size of 1-1000 of an atom, are composed of particles twice as big as a hydrogen atom. Further, despite the great mass they still have enormous velocity. The cathode particles have a velocity of only 20,000 to 30,000 miles a second, but those projected from the radium, the Beta rays, have a velocity which sometimes is as high as 175,000 miles a second. The Alpha particles, the heavy particles, do not have as much velocity, but they have as high velocity as 20,000 miles a second.

These differences in size and velocity explain the properties of both the Alpha and Beta rays, and this discovery threw a flood of light upon the difference in properties of the two kinds of rays.

There is a third type of radiation associated with radio-active substances; the Gamma rays, which are more penetrating still, and arise out of some ethereal disturbances set up by these impacts of particles upon other particles. However, so far as our considerations of energy are concerned, we can neglect altogether these Gamma rays.

Radio-active substances then are spontaneously shooting off with enormous velocity these three kinds of particles, and this has been illustrated by the use of Prof. Cook's spintheroscope. This radio-activity is not due to any ordinary molecular change, but is absolutely independent of all chemical changes as it is of all physical changes. You can reduce a bit of uranium to the lowest temperature obtainable, or raise it to the highest temperature possible, and the rate of radiation will not vary. Radio-activity is something wholly outside the range of ordinary molecular forces. It must be something that has to do with the atom, and the radio-active substance itself, and not with simply the shifting of atoms about inside of the molecule, such as takes place in ordinary chemical changes.

This is the first time that any store of subatomic energy has been tapped by man; although in the case of the cathode rays we had the suggestion that it was possible to break up the atoms of ordinary substances under some conditions. We see, therefore, that we have a radio-active change, whatever it is, consisting in something going on in the nature of the atom of the radio-active substance.

Chemical and other investigations support the conclusion that the radio-activity consists in a slow disintegration of the atom of the radio-active substance. The first step in radio-activity consists in the projection of one or more of these Alpha particles from the atom of the radio-active body.

The three radio-active substances that are known, the only ones that are certainly known to be elements, namely, uranium, thorium and radium, are the three heaviest atoms known. The atomic weight of uranium is 240, thorium 231, radium 225. Now, according to our ordinary mechanical theory of heat, the atoms of all substances are in rapid rotation and vibration. It appears, therefore, that the heavier atoms sometimes become unstable and fly apart. There is no reason why an atom should not disintegrate and fly apart any more than why a stellar system should not explode.

Experiments show that under some circumstances certain of the elements become unstable, and because of their motions project off from themselves a part of their mass, that is, split up into smaller elements. Probably if any other radio-active substances are discovered they will be substances of very high atomic weight. Gold, bismuth and lead have high atomic weights. Whether these ever become unstable is uncertain, but so far as any test of radio-activity is concerned they are not. These are the only three which we have yet discovered which are undergoing this sort of a change.

Now with this picture of the nature of radio-activity in mind, Prof. Rutherford about a year and a half ago, made one of the most remarkable predictions ever made in the history of science. Knowing that helium, which is the element first discovered in the sun by a new line in the spectrum of the sun, and which was a few years ago discovered for the first time in the earth, and bearing in mind that helium happens to be found in nature only in connection with these radio-active elements, namely, with uranium, thorium and radium, he predicted that helium would ultimately be found to be one of the products of radio-active disintegration. When a year ago he found that these Alpha particles, which are projected by all radio-active substances, have the same mass as the helium atom, his prediction

*Lecture delivered at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

began to be more probable, and only last July Prof. Ramsay in London actually took the emanations from radium and examined them under the spectroscope and at the end of five days saw the spectrum of helium grow out of the emanations from radium, which seemed to prove exactly the thing which Prof. Rutherford had predicted, namely, that the element helium is a product of the disintegration of radio-active elements.

Now I will have one word to say on the possible life of radium, and then another word on the possible transmutation of the elements.

Radium and all radio-active substances are continually projecting particles from themselves, and they must therefore lose weight. If their atoms are becoming unstable and breaking up, of course the number of atoms that can thus become broken up is limited from there being only a certain number of atoms present, and in time all these living substances will lose weight and will lose activity. So far, no one has discovered that radio-active substances either lose weight or lose activity. They appear to be going on at the same rate as ever; but we can easily calculate from the knowledge of the mass of the projected particles and from a knowledge of the amount of energy that is given off by radium per second, namely, the fact that radium is continually giving off heat and light, that it maintains a temperature of one to two degrees higher than the temperature of its surroundings, which seems a most wonderful fact, but as soon as you have this picture of the nature of radio-activity in mind you see an explanation, because if the molecules of radio-active substances are continually projecting with these enormous velocities particles from themselves, then on account of this tremendous internal bombardment which the radium is subjected to, you can see why the temperature of radium should be held up above the surrounding temperature, and why it should radiate continually 100 calories of heat per gram per hour.

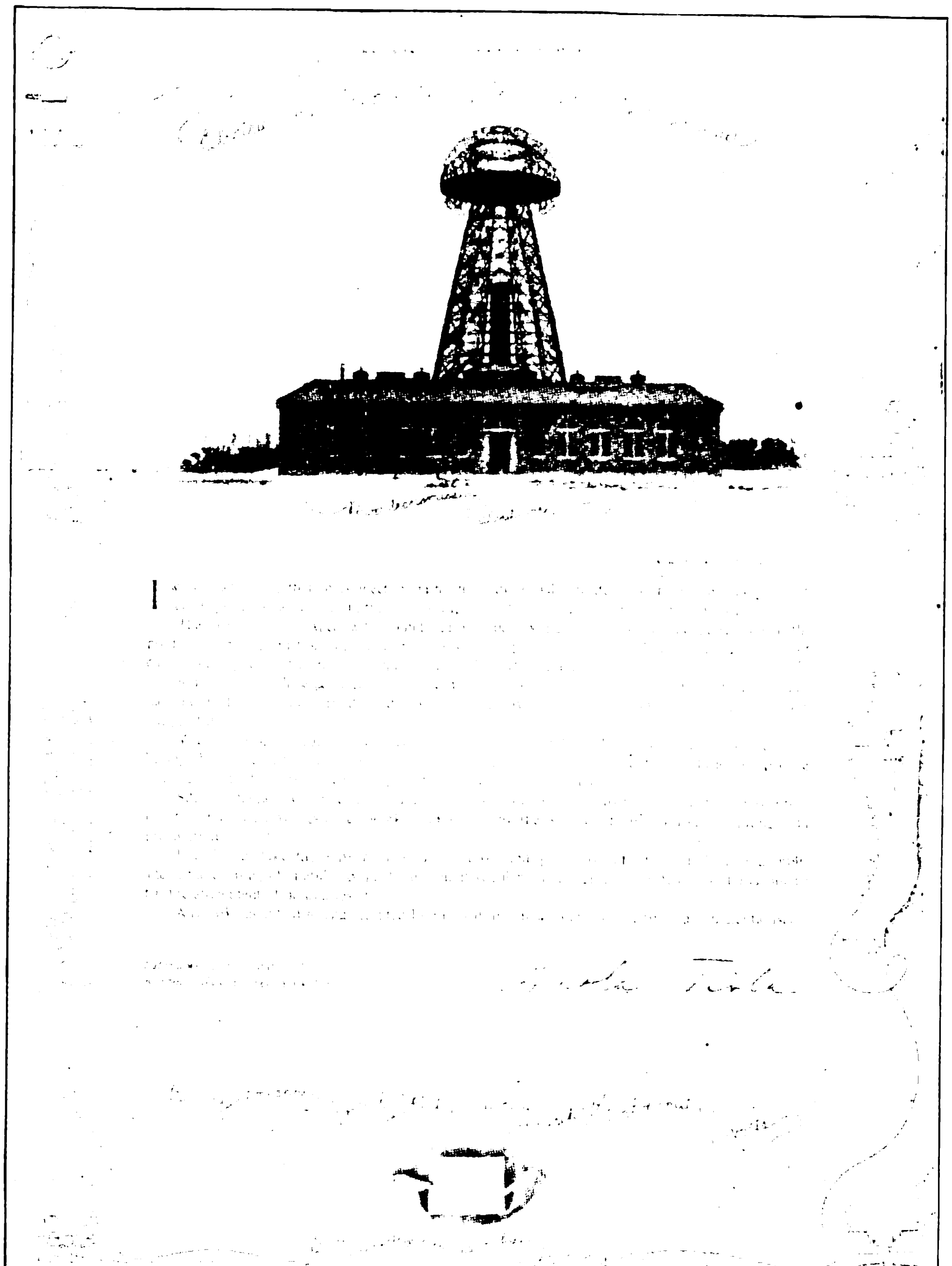
From the knowledge of the amount of energy given off from radium per second and the knowledge of the mass of the projected particles and the velocity of those particles, we know what their kinetic energy is, and we can calculate exactly how many particles are shot off per second, and we can tell the rate at which radium is losing weight and activity. On the presumption that radium all disintegrates completely into helium I have calculated the maximum possible life of helium to be 80,000 years; that is, a gram of radium will cease to be radium in a period of time not later than 80,000 years. Uranium and thorium will last a million times as long.

Now, if radium can only last 80,000 years, and if the earth has been in existence millions of years, how does it happen that radium is on the earth at present?

We see from these experiments that it looks as though the promises of the alchemists were in certain instances realized, that is, as though certain of the elements, that is these heavy ones, were spontaneously degenerating into other elements, radium into helium, uranium into helium, and solium into helium, etc., indicating a possible transmutation of the elements under some circumstances. Now, is it ever possible that you can build up from the simpler atom to the more complex atom? Is there any process in the atomic world which does for the atoms what the life process does for the molecules—which takes the simpler elements and builds them up into more complex elements? I should be rash to attempt to answer that in the affirmative, and yet the fact that radium now exists on the earth when according to our calculations it cannot live more than 80,000 years, seems to indicate that it must be produced, that is, that there are processes going on which are transmuting in both directions among atoms, just as there are among the molecules.

Now, the amount of energy which is given off from the disintegration from one gram of any radio-active substance, is a million times as much as is given off from the disintegration of any chemical compound. We have had revealed, there-

MR. TESLA'S LATEST MOVE.



fore, stores of sub-atomic energy that we never dreamed of before. The question that will arise is, is there any way in which this sub-atomic energy may be ever turned to practical use for the supply of man's economic needs? There does not seem to be any probability that it can be, because the only elements that we know of now that are disengaging that energy, are doing it at such a minute rate that unless there is some way of accelerating the process there is no probability that we can ever utilize this discovery of these stores which must be immense, of sub-atomic energy, in turning the wheels of industry.

Radium may be of some use in medicine, although it is uncertain what its place will be. It does not look now as though it will be of any economic value, but of course it is not right to say things cannot be when you remember what has been done. However, if no practical use is found for radium, yet the greatest end possible has been served, for radio-activity has extended man's knowledge of the way in which nature works and of the constitution of nature.

The Institute's Annual Dinner.

The annual dinner of the American Institute of Electrical Engineers will be held to-morrow evening, February 11, in the ball-room of the Waldorf-Astoria, 34th street and Fifth avenue. Mr. T. Commerford Martin will be toastmaster and the following gentlemen have consented to speak: Mr. B. J. Arnold, Mr. Samuel Insull, Mr. Charles L. Edgar, Dr. A. E. Kennelly, Prof. Cyrus F. Brackett and Mr. J. B. McCall.

The 25th anniversary of the introduction of the incandescent electric light and the 57th anniversary of the birth of Thos. A. Edison will be celebrated at the dinner. Mr. Edison will be the guest of honor.

The deed of trust of the Edison Medal Association will be presented at the dinner.

Branch Office Managers in Annual Conference.

The annual conference of the branch office managers of the Standard Underground Cable Company with the general sales, the manufacturing, the construction and the executive departments of the company, was recently held in the general offices of the company in the Westinghouse Building, Pittsburg, the session covering three days. The report of each manager for the year 1903 and the business prospects for the year 1904 was presented and discussed, together with ways and means for rendering more efficient service in every department to the customers of the company, who now number considerably over 1,000.

A pleasant social feature of the occasion was a theater party given by Mr. J. W. Marsh, vice-president and general manager of the company, to the visiting managers.

The branch office managers attending the meeting were Mr. Chas. J. Marsh and Mr. George L. Wiley from the New York office, Mr. Frank Clark Cosby from the Boston office, Mr. T. E. Hughes from the Philadelphia office, and Messrs. J. R. Wiley and E. J. Pietzcker from the Chicago office.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEBRUARY 2, 1904.

Electric Railways and Appliances.

750,818. Trolley Harp or Fork. Fred P. Crockett and Osro P. Johnson, Kalamazoo, Mich. Filed April 4 1903.

750,825. Automatic Trolley-Line Reel. Charles F. Davy, Mohawk, N. Y., assignor of one-half to H. M. & M. M. Scofield, same place. Filed March 19, 1903.

750,880. Means for Anchoring the Combined Third and Traction Rail of Electric Railways. John H. Morgan, Chicago, Ill. Filed July 6, 1903.

750,991. Railroad Signaling Device. Joseph R. Marchesseault, Meriden, Conn. Filed Nov. 13, 1902.

751,021. Automatic Signaling System for Electric Railways. Harry B. Snell, Cement City, Mich., assignor to the Snell Electric Signal Company. Filed April 25, 1903.

751,048. Signal System for Electric Railways. Charles P. Breeze, Norfolk, Va., and Adoniram J. Wilson, Westfield, N. J., assignors to the Hall Signal Company. Filed May 5, 1902.

751,175. Third Rail for Electric Railways. Lloyd G. Johnstone, New York City, assignor of one-half to Jacob Ahrens, same place. Filed Oct. 10, 1903.

751,298. Trolley. James Kel'y, Pittsburg, Pa., assignor of one-third to James Croak, same place. Filed July 11, 1903.

Electric Lights and Appliances.

750,894. Electric-Arc Lamp. Joseph A. Rignon, Berlin, Germany. Filed April 11, 1902.

751,013. Signal Device for Searchlight Projectors. Robert H. Read, Schenectady, N. Y., assignor to the Genera' Electric Company. Filed Aug. 2, 1901.

751,025. Electric-Arc Lamp. George E. Stevens and Walter C. Fish, Lynn, Mass., assignors to the General Electric Company. Filed June 14, 1902.

751,028. Means for Extinguishing Electric Arcs. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed Aug. 1, 1902.

751,321. Electric-Light Fixture. John J. Miller, Pittsburg, Pa., assignor of one-half to Henry Braun, Allegheny, Pa. Filed May 21, 1903.

751,411-12-13-14. System of Lighting by Gas or Vapor Electric Lamps. Henry N. Potter, New Rochelle, N. Y., assignor to the Cooper-Hewitt Electric Company. Original application filed May 28, 1901. Divided and last application filed April 30, 1903.

Electrical Machinery and Apparatus.

750,938. Alternating-Current Wattmeter. Charles A. Brown, Chicago, Ill. Filed July 24, 1900. Renewed June 24, 1903.

750,939. Process of Measuring Watts in Alternating-Current Circuits. Charles A. Brown, Chicago, Ill. Filed Nov. 19, 1900.

750,940. Alternating-Current Motor, Charles A. Brown, Chicago, Ill. Filed July 13, 1903.

750,947. Electric Controller. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 16, 1901.

750,948. Demand-Discount Meter. Frank P. Cox, Lynn, Mass., assignor to the General Electric Compauy. Filed Aug. 15, 1902.

750,971. Switch for Series Arc-Circuits. Caryl D. Haskins, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 22, 1902.

750,972. Means for Controlling Electric Boosters. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 31, 1900.

750,980. Field-Coil Structure. Charles H. Kaler, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 5, 1902.

750,993. Electric Switch. George Monson, Schenectady, N. Y., assignor to the General Electric Company. Filed July 25, 1901.

750,995. Power-Transmission Mechanism. Emil A. Nelson, Cleveland, O. Filed Sept. 2, 1902.

751,003. Controller-Casing. Charles L. Perry, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 26, 1900.

751,007. Telltale-Register. William H. Pratt and Alexander J. R. Flego, Lynn, Mass., assignors to the General Electric Company. Filed June 24, 1901.

751,012. Fuse-Box. Robert H. Read, Schenectady, N.Y., assignor to the General Electric Company. Filed April 1, 1901.

751,015. Electrical Measuring Instrument. Lewis T. Robinson, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 10, 1902.

751,016. System of Electrical Distribution. Nelson W. Rogers, Mount Vernon, N. Y., assignor to the Cooper Hewitt Electric Company. Filed Feb. 9, 1903.

751,084. Electric Switch. Ernest A. Lowe, Plainfield N. J. Filed Jan. 17, 1902.

751,120. Electrical Controller and Brake-Operating Device. Walter W. Tice, Rahway, N. J. Filed Apri 7, 1903.

751,174. Electric Switch. William F. Irish, East Orange N. J. Filed July 23, 1902.

751,191. Electric Motor. Hiram P. Maxim, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed March 12, 1903.

751,227. Electric Cut-Out. William H. Verner, Pitts burg, Pa. Filed Aug. 28, 1902.

751,362. Thermostat. John L. Ward, Ord, Neb. Filed July 8, 1903.

Telephones and Telephone Apparatus

750,793. Selective Signaling System. Garrison Babcock, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed July 17, 1903.

750,835. Telephone-Transmitter. Ernest B. Fahnestock, New York City. Filed Dec. 2, 1901.

750,845. Switching Apparatus. John S. Goldberg, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Nov. 26, 1902.

750,953. Plug-Ejecting Jack for Telephone-Switchboards. Robert G. Dunfee, Fostoria, O. Filed June 6, 1902. Renewed Dec. 15, 1903.

751,081. Coin-Controlled Telephone Apparatus. Sherwood J. Larned, Chicago, Ill., assignor to the American Telephone & Telegraph Company. Filed Dec. 3, 1903.

751,103. Telephonic Call-Instrument. John D. Peachey East Orange, N. J. Filed Jan. 6, 1903.

751,344. Telephone-Receiver. Lewis Sands and Chas. C. Cadden, Cleveland, O., assignors to the Williams-Abbott Electric Company. Filed March 6 1903.

Miscellaneous.

750,807. Telegraph Apparatus. John E. Carney, Montgomery, Ala. Filed Feb. 24, 1903.

750,871. Exciting Compound for Batteries. Adolf J. Marschall, Little Falls, N. Y. Filed May 21, 1903.

750,876. Electric Plant for Charging Storage Batteries Joseph B. Meriam and Mark B. Crist, Cleveland, O., assignors to the Meriam-Abbott Company, same place. Filed July 25, 1902.

750,892. Gas or Vapor Electric Apparatus. Max von Recklinghausen, New York City, assignor to the Cooper-Hewitt Electric Company. Filed Oct. 17, 1903.

751,031. Massaging Implement. Julius B. Wantz, Chicago, Ill., assignor to the Victor Electric Company. Filed Oct. 15, 1903.

751,046. Plate for Storage Batteries. Joseph Bijur, New York City. Filed March 31, 1902.

751,071. Signaling Apparatus. Edwin L. Grauel, Rochester, N. Y., assignor to the National Telegraphone Company, same place. Filed March 19, 1903.

751,100. Electromagnetic Ore Separator. Ellen M. Oviatt and Alexander Dean, Denver, Col. Filed May 3, 1901.

751,150. Electromagnetic Ore Separator. Alexander Dean, Denver, Col. Filed Dec. 13, 1902.

751,161. Perforator for Use with Automatic Telegraph Transmitters. John Gell, London, Eng. Filed Nov 3, 1902.

751,164. Apparatus for Perforating Tape for Automatic Telegraph Instruments or the Like. John Gell Wellington, New Zealand. Filed May 9, 1903.

751,179. Process of Electrolytically Purifying Juices Alexander Kollrepp, Berlin, and Alfred Wohl Charlottenburg, Germany. Filed June 10, 1902

751,193. Electrical Alarm Device. Burnett Men Philadelphia, Pa. Filed July 30, 1901.

751,363. Printing Telegraph Receiver. James D. Whi London, Eng. Filed June 19, 1903.

THE TELEPHONE WORLD.

Independent Telephone Convention for Ohio.

The meeting of the Ohio and Indiana Independent Telephone Association, to be held in the Grand Hotel in Cincinnati, Wednesday, Thursday and Friday, February 17, 18 and 19, promises to be one of the most important in the history of the organization. Special rates have been secured on all railroads, and a number of manufacturers will make exhibits.

It is requested that those who are going to attend notify the secretary, E. E. Knox, Portsmouth, O.

The following programme has been arranged;

Wednesday, February 17, 9 A.M. to 3 P.M.—Registration and entertainment of delegates, secretary's headquarters.

Thursday, February 18, 10 A.M.—Reading of papers and discussions; 1 to 4 P.M., examination of exhibits; 8 P.M., the time-honored banquet will be dispensed with and a new and novel entertainment given without charge.

Friday, February 19, 10 A.M.—Reading of papers and discussions; 1 P.M., election of officers.

Telephone Merger in Iowa.

A merger of ten of the different telephone companies operating in Hamilton county has been effected in Webster City, and by the consolidation a second telephone exchange will soon be operated there. The companies which have merged are the Kamrar, Jewell-Wall Lake, Ellsworth Mutual, Williams, Stanhope & Northwestern, Randall, Jewell & South Cairo, Jewell & Northwestern, Stratford, Independent and the Blairsburg.

The following officers and directors were elected at the recent annual meeting of the Independent Consolidated Telephone Company held in Milwaukee, Wis.: President and manager, A. L. Hutchison, Weyauwega; vice-president, Dr. G. C. Marlow, Lancaster; secretary and treasurer, N. W. Low, Weyauwega; general counsel, E. R. Hicks, Oshkosh; general superintendent, O. Morseman, Milwaukee; general agent, John Kidd, Milwaukee; directors: A. L. Hutchison, Dr. G. C. Marlow N. W. Low, E. R. Hicks and John Kidd.

At the annual meeting of the stockholders of the Maryland Telephone & Telegraph Company, held in Baltimore a short time ago, the following directors were elected for the ensuing year: George R. Webb, David E. Evans, Frank A. Furst, Robert Ramsay, C. I. T. Gould, John T. Stone, Harry W. Webb, John Hubner, John Waters, H. A. Parr and Frank H. Callaway. The board re-elected George R. Webb president, David E. Evans vice-president, Stanley Baker secretary, R. F. Bonsal treasurer, and Harry W. Webb general manager.

Athens, Ga., may have a new telephone system within the next few months. L. D. Goodrum, of Pennsylvania, has been in that city representing one of the large construction companies of Pennsylvania, and agrees to furnish 'phones to business houses at $30 per annum, and to private residences for prices ranging from $18 to $24 per annum. If the requisite number of citizens agree to take the new 'phones, the company will proceed to install the system at once.

Wisconsin Independent Companies Hold Convention.

The annual convention of the Independent telephone companies of Wisconsin is now being held at the Hotel Pfister, Milwaukee, and will be in session two days, February 10 and 11. The Wisconsin association is one of the strongest of the State organizations. The question of an Independent exchange in Milwaukee will be taken up and plans formed for carrying out this undertaking. Other matters of great importance to Wisconsin companies will be discussed and an effort made to secure the co-operation of all the companies in dealing with these problems. Some of the prominent telephone men of neighboring States will take part in the programme. The more important telephone manufacture and supply houses have arranged to make displays of their apparatus.

Northern Illinois Independents Meet.

The Northern Illinois Independent Telephone Association, a district organization embracing most of the Independent companies in Northern Illinois affiliated with the Inter-State Independent Telephone Association, recently held a convention at Aurora. Twenty-two delegates were in attendance and formed a temporary organization by electing A. B. Conklin temporary president, and R. H. Gibboney of Rockford secretary.

The latest annual report of the Pennsylvania Telephone Company shows that an unusual amount of reconstruction, particularly to lines in Harrisburg, was done during the year 1903, and that many extensions and improvements were carried forward. This reconstruction included rebuilding 368 miles of toll lines and replacing 758 miles of iron wire by copper metallic circuits. In addition to the dividend of 6 per cent., the revenue of the year provided for equipments of the sinking fund, leaving a substantial balance to be carried to the surplus account.

At a recent meeting in Atlanta, Ga., of the electric light committee, it was decided to accept the bids of both the Southern Bell Telephone Company and the Atlanta Telephone Company for furnishing the city telephones during the next five years. The Atlanta Telephone Company will furnish 20 telephones besides its free list of 24 at $36 a piece. Under the new contract with the Southern Bell Telephone Company, the city gets 12 'phones free, and receives a discount of 33 per cent. on those it pays for. This is a great saving over last year.

The Narberth, Pa., borough council recently decided to permit the Delaware & Atlantic Telephone Company to string its wires on the telegraph poles and so give its telephone service to many citizens whose applications have been in for a long time. This ends a dispute that has been going on for some time, the council having insisted that all the wires be put underneath the ground. The telephone company has agreed to do this in four or five years, when in its estimation there would be business enough to do it.

Independent System for Mississippi.

The proposition of Messrs. Jones & Winters of Chicago, to establish an Independent telephone system in Meridian, is meeting with almost unanimous approval, and it is thought that not many months will be wasted before another company has been launched in that city to oppose the Bell system. F. E. Gressett, of Meridian, is corresponding with the Chicago firm relative to constructing the Independent system,

The stockholders' annual meeting of the Benzie County Telephone Company was lately held in Benzonia, Mich., and the official reports showed the company to be in a prosperous condition. Four years ago, on October 10, the company was represented by six stockholders with a paid-up capital of $620. It now has 111 stockholders, representing $35,000 capital. The State line tolls have increased over 100 per cent. and the local tolls nearly as much. The company now has over 200 miles of pole lines, 11 exchanges and 14 toll stations. W. A. Poung was re-elected president and general manager, and H. B. Woodward, secretary and treasurer. The directors are as follows: G. M. Sprout, E. Juergenmeyer, G. C. Woodward, J. Smeltzer and O. E. Putney. An 8 per cent. cash dividend was declared.

William Willison, John Heiber, Dr. Simpkinson and William Wilkinson, all residents of the river road between Ft. Thomas and Ross, Ky., have made application to the Citizens' Telephone Company of Kentucky, through their solicitor, James D. Robinson, for an extension of the company's lines from Ft. Thomas to Ross. Mr. Robinson has obtained a sufficient number of subscribers to warrant the company in extending the lines at once, which will include telephonic communication with Ross, Mentor and intervening points.

The eastern part of Branch County, Mich., is becoming famous for its rural telephone lines. There is now one line in operation starting from Quincy, covering a distance of 15 miles, with over 100 subscribers. Five other lines are already started from as many different directions, all headed for Quincy, and will be in operation as soon as the weather will permit of completing the construction.

Thomas C. Callister and James A. Kelley have installed their telephone system in the eastern part of Millard County, Utah, and intend to connect with the western part of the county at Oasis as soon as spring opens.

Telephone Incorporations.

The Dunn County Telephone Company, Ridgeland, Wis. Capital stock, $10,000. Incorporators; M. L. Randall, A. L. Gratz and J. L. Fergus, all of Ridgeland.

The Telephone Hygienic Company, Cleveland, O. Capital stock, $100,000. Incorporators: H. H. Johnson, George G. Whitcomb, F. B. Williams, T. H. Hogsett and George H Kelly.

The Center Point Telephone Company, Center Point, Ind. Capital stock, $5,000. Directors; H. F. Weber, L. Lansit, Milo A. Campbell, R. M. Bryant and H. Allendorf.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bellows Falls, Vt.—The Fall Mountain Electric Light & Power Company of this place has decided to extend its system to the village of Saxtons River, about five miles distant. The company will furnish street lights as well as house lights and power.

Bowmansville, Ont.—It is reported that the Bowmansville Electric Light Company will build a new dam and enlarge its plant in the spring.

Canton, N. Y.—The Canton Electric Light & Power Company, of which W. R. Remington is president, is said to be contemplating improvements this year.

Chicago, Ill.—Proposals will be received by the South Park Commissioners at their office until February 17 for the furnishing and delivery of about 3,000 feet of electric light cable. Address Edward G. Shumway, secretary.

Cisco, Tex.—The Cisco Electric Light Company has been incorporated with a capital of $10,000. The directors are A. L. Mayhew. W. A. McSpadden and others.

Cleveland, O.—The council appropriation ordinance for the first half of 1904 will contain an item of $200,000 for a municipal lighting plant.

Coatesville, Pa.—The erection of a village electric light plant is being contemplated.

Creston, Ia.—Mayor J. C. Sullivan, is projecting an electric light company.

Emmett, Ida.—J. H. Forbes and C. H. Oliver have entered into an agreement with this village whereby they agree to put in an electric light plant within nine months. They will put in a steam engine and boiler of 120 hp.

Fillmore, Utah.—The city officials are making an effort to install an electric light plant here early in the spring.

Flint, Mich.—An investigation made by the special light commission shows that this city can install an electric lighting system for $28,000.

Hannibal, Mo.—The citizens have voted to issue $100,000 of bonds for installing a new electric light plant.

Hersey, Mich.—The flouring mills here recently destroyed by fire will be rebuilt. The new plant is also to be equipped with machinery to light the streets of the village with electricity.

Hilton, N. Y.—The people of this place are greatly in favor of an electric lighting plant.

Indianapolis, Ind.—City Engineer K. Jeup has completed plans and specifications for the public electric lighting, and bids will probably be received in five or six weeks. A contract has been drawn for 10 years, and provides for furnishing a minimum of 1,600 lights and a maximum of 2,100.

Kewanee, Ill.—The stockholders of the Kewanee Light & Power Company have authorized the expenditure of $50,000 this year for improving the plant.

Koochiching, Minn.—The village council has adopted a resolution calling for bids to install a municipal electric light plant.

Kutztown, Pa.—The project of lighting Cottage Grove avenue with electric lights has been revived.

Long Beach, Cal.—A municipal electric light plant is being petitioned for. W. A. Foster is city engineer.

Mason City, Ia.—The city is considering the matter of installing an electric light plant. The citizens may vote on the proposition at the next election.

Mitchell, S. D.—The electric company has disposed of the electric lighting plant in this city to J. B. Mickelsell and Fred Fairchild, both of Plankinton. The new proprietors will increase the capacity of the plant and add new machinery.

New Orleans, La.—The Consumers' Electric Company, of which Jules Dreyfous is president, will, it is stated, at once proceed to erect a large plant.

Northumberland, Pa.—The Northumberland Light, Heat & Power Company has invited bids for a new plant of about 250 hp.

Palouse, Wash.—The electric light system here is to be materially extended.

Preston, Ont.—The town council has engaged R. A. Ross, electrical engineer of Montreal, to report on the value of the existing electric light plant, and the cost of installing a new plant.

Reading, Pa.—Mr. Wunder has presented an ordinance to provide for the holding of a special election to secure the assent of the voters to a loan of $200,000, for the purposes of erecting, maintaining and operating an electric light plant.

Richibucto, N. B.—The establishment of an electric lighting plant here is possible. Richard O'Leary and H. H. James are interested.

St. Marys, O.—This city will sell $20,000 worth of electric light and waterworks bonds March 1.

Virden, Ill.—The Virden Electric Light Company has been incorporated with a capital of $15,000 by J. M. Hairgrove, U. G. Tucker and C. W. Carr.

Walnut, Ia.—The city council has adopted plans for a $14,000 electric light plant.

Webster, S. D.—A committee has been appointed by the city council to investigate the capacity of the machinery in the power house for the increased demand of electric lights.

Woonsocket, S. D.—The business men are contemplating the installation of electricity to light the streets of this city.

Zionville, Ind.—There is a movement on foot to build an electric lighting plant here.

STREET RAILWAYS.

Albany, N. Y.—The Electric City Railway Company, of Niagara Falls, was incorporated last week to operate a street surface road, eight miles long, in Niagara Falls. The capital stock is $80,000 and the directors are Alvah K. Potter of Lockport, and Arthur Schoelkoff, James S. Simmons, Henry H. Findlay, S. P. Fanchol, Patrick F. King, Henry L. Colpays, Frank E. Reid and Frederick J. Brown, of Niagara Falls.

Arkansas City, Kan.—L. H. P. Northrup, who was given a franchise to build an electric railway in this city and an interurban road between here and Winfield, and this city and Chilocco, has employed Thomas V. Hall & Co., consulting engineers, and the latter will have civil engineers begin the survey about the 15th of this month.

Bordentown, N. J.—The Camden & Trenton Railway Company, in which M. J. Perkins o Riverside is interested, has invited bids for the addition to its power house here. A complete line of new equipment, boilers, generators, etc., will be installed,

Chanute, Kan.—D. W. Spooner, chief engineer of the proposed railway known as the Spooner road, which has been surveyed to run through this section from Joplin to this city, declares that the road will be built this summer.

Denver, Col.—An electric railway capitalized at $1,000,000, is projected for freight and passengers through Weld and Larimer Counties.

Far Rockaway, N. Y.—The agitation for a new and direct road leading from the Bayswater section to the ocean front and to Edgemere and Rockway Beach has brought about a desire among residents in that section to have the trolley extend its tracks through Bayswater.

Greenville, S. C.—Construction will soon begin on the interurban trolley between this city and Anderson, belting the thickest settled mill district in the South.

Hillsdale, Mich.—Dr. P. P. Duckett is president of the new electric road that is to be built here.

Kingman, Ind.—Col. A. G. Madden, of this city, has promoted an electric road from Covington to Rockville, which will be financed by Eastern capital.

Richmond, Va.—Because the city council threatens to require the Virginia Passenger & Power Company to install a combined double overhead trolley and underground conduit system at an enormous expenditure, Frank Jay Gould, the principal owner of the road, has ordered all work of improvement in this city and Petersburg to stop.

Taylorville, Ill.—The Corn Belt Traction Company has been incorporated with a capital of $210,000.

Ventura, Cal.—John Burson, has announced that active construction upon the Ventura-Bakersfield Electric Railway would begin February 15, and that by March 1 between 500 and 1,000 men will be employed.

Vincennes, Ind.—The Vincennes, West Baden & Louisville Traction Company has been awarded a franchise to construct and operate an electric line here.

POWER PLANTS.

Kenosha, Wis.—The Kenosha Gas & Electric Company has decided to add an electric power plant at a cost of $10,000.

Lindsay, Ont.—The Eugenia Falls Water Power & Electric Company has been organized to develop water power. George F. Madden of Toronto and E. F. Reesor of this city are interested.

New Freedom, Pa.—A. Reehling, clerk, states that an election will be held February 16, at which the matter of power plant and waterworks will be voted on.

Petersburg, Va.—The Virginia Passenger & Power Company is now building a dam in Dinwiddie County, five miles above here, to furnish water power for two electric plants to be established, one at this dam and the other at the locks, two miles above this city. This dam, with the two plants, will cost $1,500,000.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12⅝c.; Lake 12⅜@12½c.; casting, 12⅛@12¼c.

The time for depositing Chicago Lake Street Elevated securities has been extended to March 5.

A meeting of the stockholders of the United Traction Company, Albany, N. Y., will be held on March 1.

The Boston Elevated Railway Company has declared its regular semi-annual 3 per cent. dividend, payable February 15.

Demand in Philadelphia for United New Jersey continues at 266; the market has, however, been pretty well cleaned up of the stock.

The report that the Allis-Chalmers Company will extend its field to the manufacture of electrical machinery is confirmed in Chicago.

A director of the Philadelphia Electric Company was quoted as authority for the statement that an assessment will be levied on the stock in a short time, possibly in April.

The Kings County (Brooklyn) Electric Light & Power Company has declared the regular quarterly dividend of 2 per cent., payable March 1. Books close February 20 and reopen March 1.

General Electric and Westinghouse stocks declined nearly five points on Monday. The coming decision on the franchise tax, the Baltimore fire and war news were the alleged causes of the decline.

The next dividend on Cincinnati Street Railway stock in April will be at the rate of 6 per cent. per annum, and this rate will be guaranteed by the Cincinnati Traction Company (the Widener-Elkins Syndicate).

The United Traction Company, which operates the street car system in Albany, Troy, Cohoes, Watervliet and Rensselaer, N. Y., on Saturday gave a mortgage of $6,500,000 to redeem outstanding bonds and improve the road.

At the stockholders' annual meeting of the Western Electric Company, C. W. Amory, Thomas Sherwin and Charles Williams, Jr., retired from the board of directors and were succeeded by Charles S. Holt, James W. Johnston and Charles G. Dubois.

Interborough Rapid Transit stock suffered a heavy decline on Monday. From the top price of the day, 104½, a decline to 101½ was made, netting a loss of 3 points. Subsequently about a point of this loss was recovered, the stock closing at 102¼.

The trolley car system of Baltimore was partially resumed on Monday evening, an hour or two after the great fire, which raged for nearly 38 hours, had been brought under control. The main power house is a total wreck and it will take weeks to replace it.

The proposition of the Massachusetts Electric Companies for more power is gradually rounding into shape. The management is laying out between $2,500,000 and $3,000,000 in new power plants, scattered over its entire system, but it will take two years to complete this work, owing to the delay in securing turbine engines from the General Electric Company. Already nearly $10,000,000 of new money has gone into the properties, yet the extent of the lines is so great that this large expenditure of money is hardly noticeable except to the directors, who realize the condition of the 39 properties when they were put together into two great systems controlled by the Massachusetts Electric Companies.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Feb. 8.
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	140⅛
Metropolitan Street Railway	115¼
Metropolitan Securities	83
Ninth Avenue	200
Third Avenue	120
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	38⅞
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	64
Philadelphia Traction	97½
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	140
West End Street, com	90½
do. do. do. pref	109
Chicago.	
City Railway	165
North Chicago	87
Union Traction, com	5¼
do. do. pref	30
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	22
do. do. pref	48
Electric Lead Reduction	⅞
Electric Vehicle, com	10
do. do. pref	14
Westinghouse, com	158⅛
do. pref	194
General Electric	165
Boston.	
Edison Electric Illuminating	235
General Electric	166
Massachusetts Electric Companies, com	20¾
do. do. do. pref	77½
Westinghouse Electric & Mfg., com	79
do. do. do. pref	90
Chicago.	
Chicago Edison	149
National Carbon, com	28
do. do. pref	96
Philadelphia.	
Electric Company of America	7¾
Electric Storage Battery, com	60
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	122⅞
Western Telephone Company	11
New England Telephone Company	120
New York.	
American Telegraph & Cable Company	86½
Commercial Cable Company	180
Mexican Telephone Company	2
New York & New Jersey Telephone Company	140
Postal Telegraph Cable Company	....
Western Union Telegraph Company	87
Miscellaneous.	
Chicago Telephone Company	120
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	27¼
Consolidated Car Heating	66
Standard Underground Cable	200

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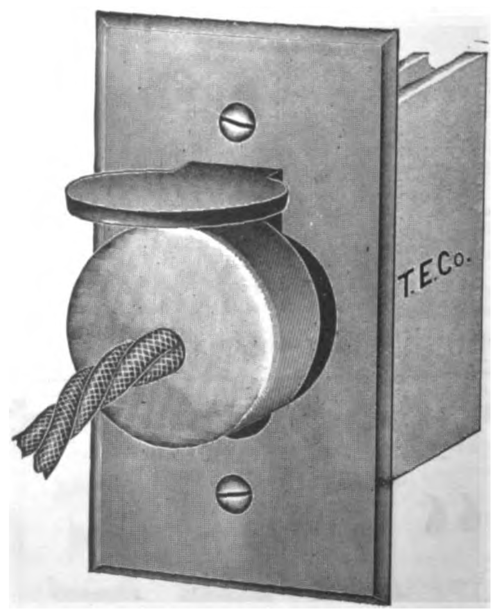

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ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

The Proposed Engineering Building.

As probably every member of the American Institute of Electrical Engineers is aware, Mr. Andrew Carnegie has offered to donate one million dollars or more for a new and up-to-date engineering building to be made use of jointly by the Institute, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the Engineers' Club.

As is generally known by the engineering fraternity the preliminary plans for this building include a general meeting room, committee and other rooms for each of the societies, in addition to a general and well equipped lecture room for large meetings of the above mentioned and kindred societies; and a large and handsome library room, a section of which may be used by each of the societies, or separate library rooms for the respective societies, as they may prefer. The home of the Engineers' Club will be in a separate adjacent building.

In order to secure the benefits which will accrue to the profession generally, and to the membership of the societies in particular, from such an attractive and permanent home as is planned, it is necessary for the societies to furnish the site. The latter can only be obtained through contributions, and the members of the Institute should one and all donate something, if only a small sum, towards the fund. Men as busy as are electrical engineers frequently procrastinate in matters of this kind, but the securing of a site for this new building is too important to be lightly shoved aside—so be sure and put your name down *at once* on the subscription blank that the Secretary of the Institute Committee sends you.

New York Tunnels.

Everything seems to indicate that before many years pass there will be a network of rapid transit tunnels under Manhattan Island.

Reports that the Interborough Rapid Transit Company, of which August Belmont is at the head, had prepared plans to connect the subway system of Manhattan with the trolley lines in Queens by means of a tunnel under the East River were practically confirmed last week, when it was learned that engineers had been at work on the plan for some time.

Mr. Belmont has acquired a controlling interest in the old Steinway syndicate which proposed to build a tunnel from Long Island City to 42d street, Manhattan, and thence to 10th avenue. Work on this tunnel was begun several years ago, but an explosion in the shaft in Long Island City crippled the old corporation financially. Mr. Belmont purposes to conduct the undertaking as a private enterprise.

When the tunnels under the North River are completed it is said that a complete system of transfers will be established whereby passengers can ride from Long Island City to New Jersey, the connecting link being supplied by the rapid transit subway.

Engineers who have studied the proposition have reported that the tunnel can be built in less than two years. It is to be located several blocks north of the Pennsylvania Railroad tunnel and below the Blackwell's Island bridge. The present trolley lines in Queens cover 60 miles of track and carry nearly 12,000,000 passengers a year. The tunnel plans may be submitted to the Rapid Transit Commissioners this month.

In spite of all the tunnels that are being built Greater New York is really behind the times and the work should have been

begun several years before it was. By the time the rapid transit tunnels are completed and electric trains running the population of the city will have increased to such an extent that the facilities for rapid transportation will be inadequate.

Owing to the peculiar shape of Manhattan Island possibly no real relief from congestion of traffic will be had until air-ships are perfected.

* * *

The Bell Company's Financial Needs.

It has at last been finally decided that the American Telephone & Telegraph Company (Bell) will need $20,000,000 this year, and a leading interest in the company intimates that "a part of the new capital issue will be for the acquirement of certain independent companies which it can secure at an equitable price."

Of course the "acquirement of independent companies" is only talk, but is good bait to throw out when issuing new bonds "to be later convertible into stock," and we think that before President Fish returns from his trip to the Pacific coast he will learn that the independent movement is making rapid strides—not only on the coast but throughout the West.

Since January 1 rumors have been plentiful that the American Telephone & Telegraph Company might make an issue of convertible bonds this year, but some one in authority would send out a report that "the company declared that absolutely no consideration had yet been given the question of the company's financial needs this year and therefore any reports as to the company's intentions had no foundation, in fact the directors had not reached the point of considering suggestions."

Now comes official news from headquarters, issued on Friday last, that "the American Telephone & Telegraph Company will this year need $20,000,000, but it may not need this money until fall, although the company generally raises its money in July. It may be that the company will this year issue convertible 5 per cent. bonds. It may be considered better policy for the American Company to become a borrower of money this year than issue new securities if market conditions are not better next summer than at present."

We guess that President Fish will discover before he returns from the coast that it will take a "bunch" of money to carry on the war against the independents, and that he will not wait until the "good old summer time" before sending out his pronunciamento to the dear public that the $20,000,000 convertible bond issue is ready for investors.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The next annual business meeting of the American Electrochemical Society will be held in Washington, D. C., April 7, 8 and 9.

The Interurban Street Railway Company of this city has changed its corporate name to the New York City Railway Company.

Late news from Baltimore says that revised estimates of the fire losses are now placed at $85,000,000 or less, three-fourths of which are insured.

Mayor Weaver of Philadelphia declared himself on Saturday as unqualifiedly in favor of three-cent fares on city trolley cars. "I would like to see the city own its street railway lines," he said, "and charge three-cent fares; but I question the practicability of municipal ownership of the railways at this time."

Radium in the mica deposits of the eastern and western provinces of Canada is an alleged discovery that has caused a stir in Ottawa. Mr. Obalski, Government inspector of mines, is certain that the rare metal will be found in quantities.

The quarterly meeting of the board of directors of the National Electrical Contractors' Association was lately held in Washington, D. C. The directors paid a visit to the White House, where they were received by the President, who expressed his pleasure at meeting the directors, and called their attention to the large and constantly expanding field for electrical work offered by the Philippines, The next meeting will be held in St. Louis September 13-16, at which time officers will be elected.

Frederick S. Dickson, president of the Cuyahoga Telephone Company of Cleveland, O., has won his fight against President Roosevelt and Postmaster General Payne. The latter, with the President's sanction, ruled that post offices throughout the country should use only one telephone, viz., the one that had long distance connection with Washington. This meant the loss of a large sum to the independent telephone interests of the country. Dickson pleaded with President Roosevelt to intercede, but without success; but through many Senators and Representatives he has succeeded in getting the Payne ruling modified so that the independents will have a chance.

The largest searchlight in the world has been completed and will be used for advertising purposes at the Louisiana Purchase Exposition. The machine weighs 7,000 pounds, is of 2,250,000 cp., and projects a beam of light 7 feet in diameter.

An electrical system of stock raising has been developed on a moderate scale at the University of Michigan. Small animals, such as rabbits, have already been forced into matured size and plumpness in two-thirds of the period required by nature, showing the possibility of forcing the development of the larger stock.

The National Electric Light Association is sending out a notice to members regarding Mr. Henry L. Doherty's offer of a gold medal for the best and most practical paper on underground construction. Papers must be received at the office of the association not later than April 21. Three copies of each paper are requested.

A Government sanction has been obtained for an electrical exhibition to be held at Warsaw, Russia, from May to September of this year. The exhibition will include a special section for new inventions in this direction and foreign exhibitors are invited to take part. It is understood that permission is to be granted for the admission of exhibits free of duty. Interested parties should address the committee, Philharmonia Building, Moniuszki street, Warsaw.

The 241st meeting of the New York Electrical Society will be held at the rooms of the American Institute, 19 West 44th street, this (Wednesday) evening, February 17, at 8 o'clock. Mr. Ralph D. Mershon will lecture on "The Gas Engine for Central Station Service."

Owing to differences of opinion between the State, the municipal authorities and the owners of the Tuileries Garden in Paris, the electric lighting of the garden has been much delayed. The main question in dispute, as to who should direct the work, has been settled in favor of the State, and although the city engineers are actually conducting the operation of laying the wires, it is under the direction of the Government. The type of lamp decided upon by the latter is known as "Arc Nouveau."

A NEW INCLOSED LIQUID STARTING RESISTANCE.

BY FRANK C. PERKINS.

The accompanying diagram, Fig. 1, and illustrations, Figs. 2 and 3, show the details of construction of a most novel and ingenious motor starter, designed by Mr. J. H. Woolliscroft of the Sandycroft Foundry Company, Ltd., of Chester, England. The motor starting switch, seen in Fig. 2, is of the three-phase 40 hp. type and consists of a water-tight cast-iron drum, containing soda and water and fitted with internal electrodes and external contacts and terminals.

The cast-iron drum is carried on insulating bearings and is provided with an opening for supplying the liquid, the plug closing the same acting as a relief valve for the gas generated by electrolysis. The lever rotating on the axis is held by a catch when in a vertical position, while the cast-iron case containing the liquid is free to rotate when picked up by the catch actuated by the retaining coil in series with the field. The sliding con-

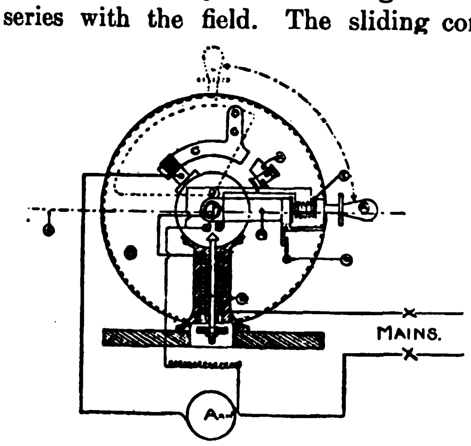


Fig. 1.—Diagram of Connections.

tact is fixed to the internal blade and rotated with the case but is insulated from it. In Fig. 1, A represents the lever, B the cast-iron case, C the sliding contact, while D is the maximum release protected inside the cast-iron bearing pedestal. The retaining catch can be seen, while the level of the liquid is indicated at F and the minimum release and catch-retaining coil is shown at E. The short circuit contact, H, is fixed at B and J, and shows the position of the insulating bearings.

The minimum release and retaining coil is in series with the shunt winding of the motor, and is carried on a lever which forms a handle rotating on the same axis as the drum. When this is energized a catch is brought into gear with a trigger on the drum, the latter being rotated by means of the handle. As the drum is caused to revolve the electrodes dip into the liquid and gradually cut out the resistance of the latter in the main circuit. By means of the special contact, H, at the extreme end of the travel of the drum the resistance is finally short-circuited.

The maximum release coil is inclosed in one of the cast-iron bearings and in case an excessive current is used during the

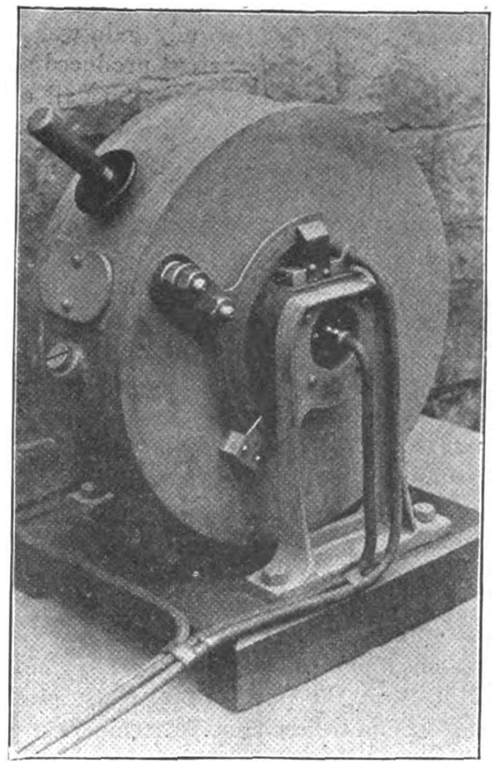


Fig. 2.
40 B.H.P. Three-phase Motor Starting Resistance.

starting or while running the motor the minimum coil is short-circuited and allows the drum to return to the off position by

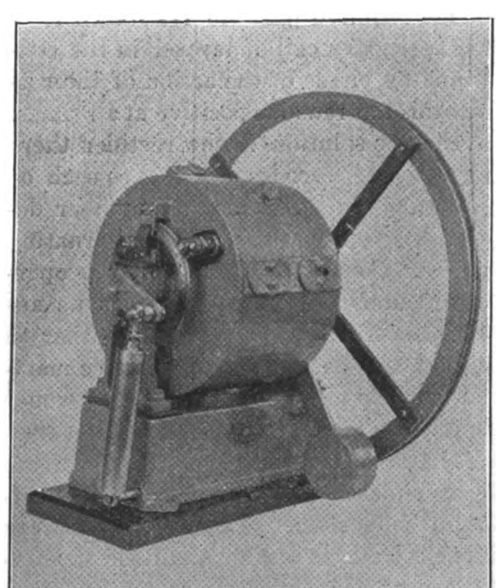


Fig. 3.
Automatic Liquid Switch for Intermittent Pump Work, Organ Blowing, etc.

gravity. This safety inclosed resistance for shunt motors, shown in the diagram, is extremely simple and safe—over-heating, sparking and irregular steps being avoided. It is provided with the usual precautions against starting the motor too quickly, excessive overloading, leaving the resistance cut out in case of current supply or switching on the armature before the field is excited.

The main switch is of course always used for stopping the motor, and the shunt will remain closed on the armature and will hold up the starter until the EMF. is reduced to zero. The electrolyte is varied in density according to the voltage used, this resistance being suitable for pressures up to 800 volts, while it is impossible to burn it out. The illustration, Fig. 2, shows a Woolliscroft inclosed liquid switch for intermittent pump work and organ blowing.

THE ELECTROLYTIC RECTIFIER AND INTERRUPTER.*

BY W. B. CHURCHER.

It is a well-nigh settled fact that there is nothing absolutely new under the sun. To the ordinary observer it matters little how much study and hard work an inventor may have given his product before it becomes a marketable commodity and he is always ready to listen to the claims of invention by some one in the obscure past who had a vague idea in his head upon the same subject. It always remains for some one not only to invent a device but to put it into such a practical shape that it can be made a useful article to society and indirectly a producer of the "where-with-all" with which other useful articles may be made available. It is not such a difficult matter to invent something new, comparatively speaking. Much hard work must be done, difficulties overcome, methods of manufacture and sale perfected before any real success is achieved. Such has been the case with the alternating current rectifier, about which more or less has been written in the last few years. It is not a newly discovered fact that aluminum and some other metals have the faculty of developing upon their surfaces an insulating film when in contact with certain solutions and while electrically positive to another electrode in the same solution, but it has remained in an unperfected state. The Churcher alternating current rectifier is a decided departure from anything before constructed and is now in marketable and practical shape. The best that has been accomplished heretofore was a very inefficient and crude device. A single cell with a pair of suitable elements will rectify part of the cycle of an alternating current, but this is not

* Paper read at the twelfth annual convention of the Northwestern Electrical Association held at Milwaukee, Wis., Jan. 20-22, 1904.

a true uni-directional current. It is still an alternating current in character with one alternation of greater amplitude than the other and giving an efficiency of perhaps 20 per cent. when charging a storage battery. This poor result is partially caused by the return or leakage current passing through the rectifier and through the battery in the wrong direction, hence discharging it. To charge a storage battery under this condition it is evident that an excessive charging current must be used to overbalance the excessive discharge that takes place during one-half of the cycle. For example, in figures that are approximately correct, to charge a battery of cells aggregating 50 volts, a potential of about 60 volts is ordinarily required. Supposing for illustration that this potential will pass 10 amperes through the cells on direct current circuit. In order to charge at this rate from an alternating current with a single old type rectifier it will be necessary to raise the charging potential sufficiently, say to 75 volts, to force 50 amperes through the cells—an excessive charge. This is because of the fact that the potential of the return wave of the alternation will be added to that of the battery and produce a serious leak through the insulating film on the aluminum electrode. The average charge potential available would be 75 less 50 or 25 volts while the average discharge potential would be 50 plus 75 or 125 volts. Average, because at the peak of the alternation the actual potential would reach about 100 volts at this point the potential against the film would be about 150 volts, which is approximately its break-down point. This high return potential, as it may be termed, will cause a discharge of about 40 amperes—an excessive discharge. This leaves a net charging current of 10 amperes. It is presupposed that a battery requiring 10 amperes would have a capacity of about 100 ampere hours, and hence it will be seen that in order to charge at 10 amperes from the old type of rectifier it was necessary to charge at 50 and discharge at 40 amperes leaving the required margin for charging. At this rate the rectifier would be rapidly destroyed and the best storage battery would be served likewise. A rectifier of this type is not worthy of further consideration, as it is of no more real value for other purposes than for charging batteries.

The next step was a combination of four rectifying cells, known as the Gratz method of connection. This combination was somewhat better in that it rectified both waves of the cycle and hence gave a true uni-directional current. The efficiency was necessarily low because of the fact that the resistance in the path of the useful current was doubled and the leakage current was also doubled. The old type of single cell being inefficient to start with the combination of four was four times as bad, to say nothing of the wear and tear on four sets of electrodes and four solutions. The only gain was a really uni-directional current produced so that in charging a storage battery all of the energy passing through it was available for discharge, barring, of course, inherent losses peculiar to storage batteries.

The next step was the perfection of the Churcher rectifier. This device rectifies both waves of any alternating current and requires but one jar, one solution and one set of electrodes to do so. In this way the internal resistance is reduced to a very low point—in fact it is only limited by mechanical necessities to prevent short circuits. This loss is almost negligible. The loss that does take place is the small leakage current. This current does not pass through the apparatus operated by direct current but is expended in heating the solution. This loss is largely dependent upon the proper initial forming of the film, the purity of the aluminum and the solution and its temperature. Where continuous service is required of the rectifier it is therefore desirable to prevent this initial rise in temperature by the use of water-cooling pipes or radiation of some form. This form of rectifier requires the use of a transformer with a secondary of twice the direct current voltage required plus the resistance loss. This secondary coil is tapped in the center and by virtue of the action of the rectifier this tap remains positive at all times. In the one solution in the rectifier there are active electrodes attached to each of the secondary terminals, the number depending upon the phase of the alternating supply. Owing to the peculiar properties of films on these electrodes no appreciable current passes from either to the other. Electrodes of inactive material, such as platinum, carbon, etc., would short-circuit the transformer. Between these active electrodes but insulated from them is placed an inactive electrode, preferably platinum. Connected between this electrode as one terminal and the center tap of the transformer as the other is the battery to be charged, direct current motor or other apparatus to be operated. In operation the current passes from the center tap of the transformer to the motor, from the motor to the inactive electrode in the rectifier solution, thence through the solution to one or the other active electrodes, depending on which is at that instant negative to the center of the transformer. Inside the rectifier the current therefore passes from the inactive electrode, first to one then to the other active electrode as the alternations of the cycle take place, the center of the transformer remaining positive at all times. It will be understood from this that one side of the transformer is active while the other is inactive, and then reversed during the next alternation. The regulation of direct current is best attained by placing an adjustable inductance between the tranformer terminals and the active electrodes of the rectifier. This regulation can also be very efficiently attained by an inductance in the main alternating supply or by varying the number of turns of wire in the primary of the transformer. This form of regulation is, of course, much more efficient than placing resistance in series with storage batteries when charging from the 110 volt direct current mains.

It is also a well known fact that a pulsating uni-directional current is especially desirable for charging storage batteries. Just why it is so is not very well understood, but the fact remains. The limit of voltage of one cell of the Churcher rectifier is about 70 volts direct current or a difference of potential across the active electrodes of about 140 volts. Somewhat higher voltage may be obtained under favorable conditions, but the efficiency is generally much lower because of the increased leakage from one transformer terminal to the other. Through the use of two cells and two secondaries in the one transformer twice the voltage can be obtained; three cells with three secondaries in the one transformer will give three times the voltage, etc. Thus it is evident that the Churcher rectifier will deliver any potential of direct current from any alternating current. This statement may seem very broad but it is perfectly true. Potential, phase, cycles, direct current, are all matters of detail readily worked out by anyone familiar with the system.

An important application of the Churcher alternating rectifier is the interrupter exclusively designed by me. Full and complete claims for this invention as well as those on the rectifier have been allowed by the Government. This interrupter gives promise of extensive application in the X-ray field, as it is a well known fact that alternating current is very inefficient for such purposes, especially when the frequency is over 60 cycles. The Churcher alternating rectifying interrupter will receive any potential, any phase or cycle of alternating current and deliver a rapidly and completely interrupted direct current through the primary of an induc-

tion coil. Its construction and mode of operation is similar to the Churcher rectifier, the only difference being in the area of exposed contact of the positive electrode. The large area of the positive electrode gives a perfect contact with the solution, but in the rectifying interrupter the opposite condition is present. The positive electrode in this case is of restricted area; restricted to such a degree that instantaneous interruption of the current is obtained by the well-known Wehnelt effect. By the regulation of the amount of positive electrode exposed any volume of interrupted current can be produced. This interrupted direct current from the Churcher rectifying interrupter on alternating supply is more desirable for the purpose than the regular 110 volt direct current as the potential is somewhat less, and hence more easily and completely interrupted without destruction of its parts. These two inventions, however, mark a long stride in the subject of actually applied commercial electricity. The invention and perfection of the interrupter especially has excited the greatest interest in the field in which it is applicable.

ELECTRICAL STATION PRACTICE.

ARTICLE XXIV.

BY W. H. RADCLIFFE.

Next in importance to the alternators installed in a central station, in which alternating current is generated, are the transformers. By means of these the pressures developed in the alternators are increased many times before they are supplied to the line wires; this is done in order to proportionately decrease the currents and so reduce the loss in transmission due to the resistance of the line wires, which loss in any one installation is proportional to the square of the current. Transformers used in this manner at the generating end of the line to increase the pressures are called step-up transformers, whereas in sub-stations at the distributing end of the line other transformers are used to reduce the pressures to values which are considered safe for service, and these are termed step-down transformers.

Transformers as a whole are simple in construction, high in efficiency, and comparatively inexpensive. Their principles of operation are also readily understood. Essentially, a transformer consists of a closed iron core on which are wound two separated coils of insulate wire. One of these coils, known as the primary or low-pressure winding consists of a comparatively few turns of large wire, while the other coil, known as the secondary or high pressure winding, consists of a large number of turns of smaller wire. The proportion of the number of turns in the primary coil to the number of turns in the secondary coil is called the ratio of the transformer. The step-up transformer at the generating station has its primary coil in connection with the terminals of the alternator and its secondary coil in connection with the line wires; the step-down transformer at the receiving station has its secondary coil connected to the line wires and its primary coil joined to the distributing circuits.

The fundamental principles governing the operation of both step-up and step-down transformers are practically the same, but for illustration the step-up transformer at the generating end of the line will be considered. Suppose for the present that the connection with the line wires has not been made, but that the primary circuit of the transformer is being supplied with an alternating electromotive force by the alternator. An alternating current whose strength is directly proportional to the value of the impressed electromotive force and inversely proportional to the resistance and reactance of the primary winding will pass through it. This primary current encircling the iron core magnetizes it first in one direction and then in the opposite direction many times per second, depending upon the frequency of the current, which by the way is known as the magnetizing current of the transformer. There is, therefore, a certain loss of energy going on in the magnetization of the transformer core, no matter whether the secondary coil is in use or not. This loss is called the core loss of the transformer, and in any given case is practically constant at all times the transformer is supplied with current. The core loss, in reality, is composed of two approximately equal losses, the eddy-current loss and the hysteresis loss, both of which result directly from the reversals of magnetism within the core. The eddy-current loss may be made low by laminating the iron core of the transformer at right angles to the flow of the eddy currents; that is, instead of casting the core in one solid piece, building it up from sheet-iron strips of about 14 mils in thickness stamped in the desired shape and enameled or japanned on both sides. The hysteresis loss will remain within reasonable limits if the iron used for the core be of good quality and of sufficient cross-sectional area that it be not overcrowded with lines of force under normal conditions.

Let us next turn our attention to the conditions existing in the secondary coil which is yet an open circuit. Assuming there is no leakage of the lines of force outside the iron core, all of them intercept the secondary coil upon each reversal of the alternating current and therefore develop therein an alternating electromotive force which is proportional to the number of turns composing this coil multiplied by the rate of change of the lines of force through it. Stated in another way, there is developed in each turn of the secondary coil an electromotive force which is equal in value to that in each turn of the primary coil; consequently the total electromotive force that may be obtained from the secondary coil will be that proportion of the primary electromotive force as the number of turns in the secondary coil is to the number of turns in the primary coil.

Now, suppose that the necessary connections be made between the secondary coil and the line wires so that this circuit is closed. The electromotive force developed in the secondary coil will now, since the secondary circuit is closed, force through this circuit an alternating current which will have the same frequency or number of reversals per second as the primary current. There will, however, be a difference in phase of approximately 180 degrees between them; that is, the direction of the induced secondary current at any one time is nearly opposite to that of the primary current, tending in consequence to decrease the magnetization of the transformer core. This tendency to decrease the number of lines of force through the core is proportional to the strength of the secondary current, but there is an inclination for the primary current to increase on account of the lower magnetization, so that the result, so far as the core is concerned, is actually unchanged. Owing to this tendency for the primary current to increase with an increase of secondary current, the transformer is practically self-regulating, and since the resistance loss of the transformer is equal to the product of the resistance of the primary winding and the square of the primary current, this loss consequently varies according to the strength of current in the secondary circuit.

The three losses previously mentioned (the eddy current loss, the hysteresis loss, and the resistance loss in the primary winding) together with the resistance loss in the secondary winding, which latter is equal to the product of the resistance of the secondary winding and the square of the secondary current, constitute the factors tending to decrease the efficiency of the transformer from the ideal mark of

100 per cent. Of these four losses we have seen that two of them are practically constant at all loads, and that two vary as the square of the currents. The efficiency of a transformer, that is, the ratio between full load primary and full load secondary, will therefore be greatest when the load on it is such that the sum of the constant losses equals the sum of the variable losses. In general, transformers designed for high frequencies and large capacities are more efficient than those designed for low frequencies and small capacities. As a whole, however, a transformer leaves but little to be desired as regards efficiency, a modern 60-cycle transformer of 50 kilowatts capacity or more possessing an efficiency of approximately 98 per cent. at full load and an efficiency of about 97 per cent. at half load. In designing a transformer it is important to so proportion its parts that the point of maximum efficiency occurs at that load which the transformer usually carries in service. In many alternating current installations, comparatively light loads are carried the greater part of the time, the rated full load or an overload being occurrences of short durations. For such purposes special attention should be given to the designing or selecting of transformers having low core losses rather than low resistance losses, because the latter are then of relatively small importance.

The "all-day efficiency of a transformer" is an expression commonly met with in practice, and denotes the percentage that the amount of energy actually used by the consumer is of the total energy supplied to his transformer during 24 hours. The formula for calculating the all-day efficiency of a transformer is built upon the supposition that the amount of energy used by the consumer during 24 hours is equivalent to full load on his transformer during 5 hours, and is as follows:

$$E = \frac{5w}{24c + 5r + 5w}.$$

Here E = the all-day efficiency of the transformer,
w = the full load in watts on the primary,
c = the core loss in watts,
r = the resistance loss in watts.

The all-day efficiencies of modern types of transformers average about 85 per cent. for those of 1 kilowatt capacity, 92 per cent. for those of 5 kilowatts capacity, 94 per cent. for those of 10 kilowatts capacity, and about 94.5 per cent. for those of 15 kilowatts capacity.

The energy dissipated in the losses of a transformer reappears as heat in the windings and core. This heat not only increases the resistances of the windings and core, producing thereby a further increase of their respective losses, but in addition causes in time a peculiar effect on the iron core which is intensified by the reversals of magnetism constantly going on within it. After about two years' service, the iron apparently becomes fatigued or tired, and this phenomenon is called aging of the iron. Since the life of the transformer depends to a great extent upon this factor, the conditions responsible for its existence should as far as possible be removed. Means must therefore be provided in the construction to radiate the heat as quickly as it is generated. In transformers designed for low outputs, that is in those having capacities below 10 kilowatts, sufficient radiation is obtained by exposing the core and windings as much as possible to the surrounding air. The amount of heat thus dissipated under a given rise of temperature, increases proportionately to the amount of surface exposed, but since in transformers of large outputs the amount of surface exposed to the air per unit of capacity is not as great as in transformers having low outputs, other modifications of this method and other mediums more efficient than air, are brought into service for the purpose of cooling the working parts of these transformers.

A modification of the method just mentioned consists in forcing a continuous blast of air through the core and coils, both of which are spaced so as to provide a system of air ducts which permit of a free circulation of the air. The air blast is maintained by a blower usually operated by an electric motor, and where several transformers of this type are in use a single blower can generally be arranged to furnish an air blast that will be sufficient for the entire installation. The pressure of the air in each transformer may be regulated by means of a damper in its cover, and the amount of air passing through the ventilating ducts in the core may also be governed by another damper in the side of each transformer.

Oil is also used to a great extent in transformers for dissipating the heat of the windings and core by conducting it to the transformer case. The oil entirely surrounds both the core and coils, and is held in an iron case which completely surrounds the working parts of the transformer, and which is corrugated to increase the amount of surface exposed for radiation. Oil is not only more efficient than confined air in this respect, but its high insulating properties and its puncture-repairing qualities render it particularly adapted for use in installations employing high pressures and heavy currents. In order that the insulation on these leads from the primary and secondary coils of this type of transformer may not act as a wick and thus draw out the oil, the insulation on these leads is removed for a portion of their length and insulating sleeves of special construction used in their stead.

In alternating current installations, where particularly heavy currents are employed, and where the heat developed within the transformers is therefore considerable, special means are taken to maintain the temperature of the oil used therein, at a low temperature. The device employed consists of a coil of pipe surrounding the top of the transformer, and through which a stream of cold water is forced. The oil in contact with the core and the windings thereon, becomes heated above that in other portions of the transformer and rises in consequence through the working parts to the cold water pipes where it becomes cooled, after which it passes down around the outside of the core. A continuous circulation of the oil is thereby produced which results very effectually in maintaining a low temperature throughout the transformer.

The regulation of a transformer is the difference between the secondary voltages at no load and at full load, and is generally expressed as a percentage of the secondary voltage at no load. Its value is governed by the resistance and the reactance of the windings. Decreasing their resistances by employing conductors of greater cross-section, or decreasing their reactances by dividing the coils into sections and closely interspersing those of the primary winding between those of the secondary will improve the regulation. In transformers where there is a great difference in voltage between the primary and secondary windings, however, this remedy has its limitations on account of the great amount of insulation which must necessarily be used between the windings, and which therefore causes the distance between them to become such as to cause considerable leakage of the lines of force. Transformers of large capacity usually have a better regulation than those of small capacity, but in no case should its value exceed 2 per cent. In certain 1,875 kilowatt transformers recently constructed the regulation was 1 per cent.

As to the construction of transformers there are on the market two distinct types, in one of which the primary and

secondary coils surround the iron core, and in the other the core surrounds the coils. The former are known as the core type, and the latter as the shell type. The principal advantages possessed by transformers of the shell type are a larger proportion of core surface exposed for radiation of heat, and a shorter magnetic circuit which reduces the tendency for a leakage of the lines of force into the air. The primary and secondary coils are usually wound with insulated copper strap, and in some cases they are arranged one within the other, while in other cases they are placed on the core side by side. Both methods have advantages and disadvantages as compared with the other. In the former arrangement there is less magnetic leakage, but also less surface exposed for radiation and greater difficulty in providing efficient insulation between the two circuits; in the latter arrangement there is more surface exposed for radiation and less difficulty in insulating the windings, but there is also a great leakage of the lines of magnetic force into the outer air. Usually there is but one primary winding but the secondary winding is generally divided into two equal sections, the four terminals of which are permanently wired to four connection blocks which may be connected so as to throw the secondary sections either in multiple or in series with each other at will.

SOME PRACTICAL POINTS IN ARMATURE CONSTRUCTION, DEALING CHIEFLY WITH INSULATION.*

BY H. S.

This short descriptive paper was originally written to impart information to the workmen engaged in armature construction at a works with which the author is connected. It was appreciated by those to whom copies were given, and it is thought that the hints contained therein may be of interest and service to others engaged in this class of work. Possibly, also, it may be of interest to those in charge of electrical plant who have occasionally through force of circumstances to undertake their own repairs, etc., and who, from want of opportunity, have not been in a position to acquire much electrical knowledge. To electrical engineers it is, of course, elementary in character, and is not intended for their perusal. An explanation is given of various points which are important in the winding and construction of armatures. The points to which attention is directed are illustrated by sketches, and any intelligent workman will readily see what parts and places require the greatest care in insulating, etc.

Insulation from the core, spindle, and any other parts in metallic connection with the same, is equally important in every type of armature, whether it be Gramme ring, or wire-wound drum, bar-wound drum, or slotted core. It should be borne in mind that "no chain is stronger that its weakest link," and if an armature breaks down to "earth," it will do so where the insulation is thinnest or weakest, or where it is liable to be injured mechanically, and thereby weakened under ordinary running conditions. Thus, equally great care must be taken with the insulation of all parts.

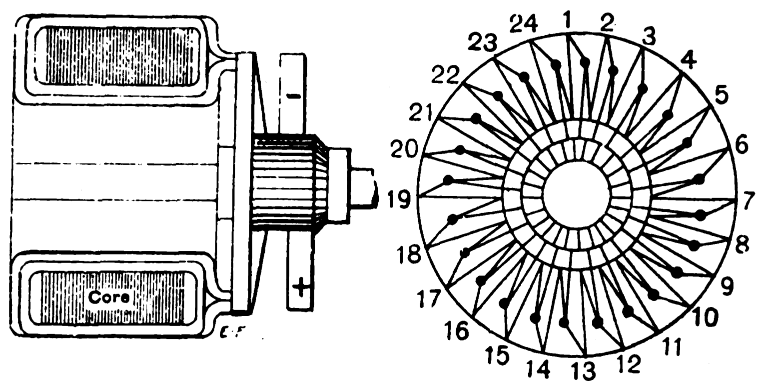


FIG. 1.

Gramme Ring Winding, showing top end of one coil and inside end of next coil joined together at the commutator arm.

The insulation of the core, etc., having been made as perfect as possible, the next point which demands attention is the insulation between the various wires or bars. It will be readily understood that the place where a short-circuit is most likely to occur—supposing that the insulation is equally good everywhere—is where the greatest difference of potential (or, in other words, the greatest number of volts) exists between wire or bars close to or touching one another. The position of these points of greatest difference of potential varies in different classes of armatures, depending on the method of winding, and a short description follows showing where these important places are situated in the various types of armatures.

Two-Pole Gramme Ring Armatures.—This form of armature winding is one of the safest from "short-circuit," for, as will be seen by reference to Fig. 1, the greatest difference of potential is between the conductors and commutator parts at opposite ends of a diameter all the way round. The greatest pressure between any two wires touching one another can only amount to a small portion of the total number of volts. Thus, if an armature is wound with 50 sections, roughly speaking each section will contribute one-twenty-fifth part of the total voltage. If the armature is to give 100 volts, it means that each coil or section will have to give 100/25 = 4 volts, so that the pressure between each section and its neighbor is very little.

Two-Pole Smooth-Core Drum-Wound Armatures.—With all drum-wound armatures the case is different. Instead of each conductor completing its circuit by returning through the inside of the core, as in the Gramme ring-winding, it passes across the end of the core and along the opposite surface, each section or coil usually consisting of one long bar attached to a commutator section and one short bar on the opposite side. Now, a commutator section opposite to the one just mentioned will also have a long bar attached to it. This long bar will, therefore, be lying near to, in fact, touching the short bar belonging to the first-mentioned section or coil. Thus it will be seen that there is the full voltage of the machine between every adjacent long and and short bar all the way round the armature. It is necessary, therefore, to insulate the long bars from the short bars very thoroughly and well, especially where the long bars pass over the "crossings" or "end connections" to which the short bars are attached, because these joints are bare. The strip of mica cloth generally employed forms an excellent means of insulating this place, but to be thoroughly effective it should be at least ½ inch wider than the leg of the "crossing," A, so as to project ¼ inch. beyond the bare metal on each side. Care should also be taken that the insulation on the long bars themselves is continued quite close up to where they join legs, B, of the "crossings." The difference of potential between each "crossing," C C, is very small, but there

*From the "Electrical Engineer," London.

is the full voltage between the inside legs, A, and outside legs, B, of the "crossings" at any point near the circumference of the armature, because the tips are attached to short and long bars, and it has been shown that there is the full voltage between long and short bars. Reference to Fig. 2 will show this clearly.

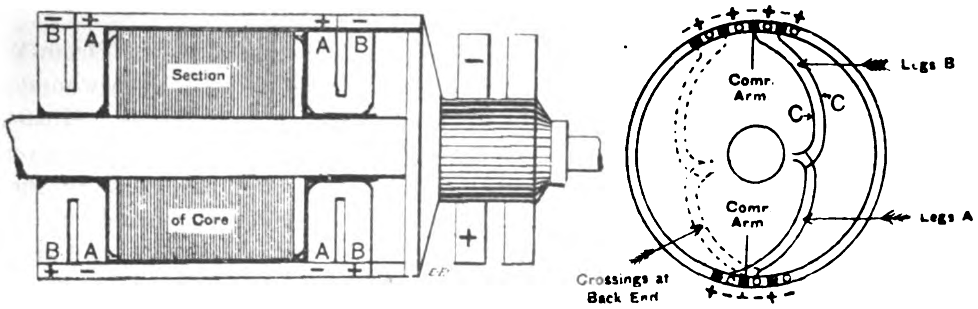


FIG. 2.—SMOOTH CORE DRUM WOUND BAR ARMATURE.

The long bars are represented by squares and the short bars by circles. What has been said above with reference to bar armatures applies also to wire-wound drum armatures, so far as the wires on the surface of the core are concerned, but the case is somewhat different at the ends of the core. This point, however, will receive attention when dealing with slotted-core armatures.

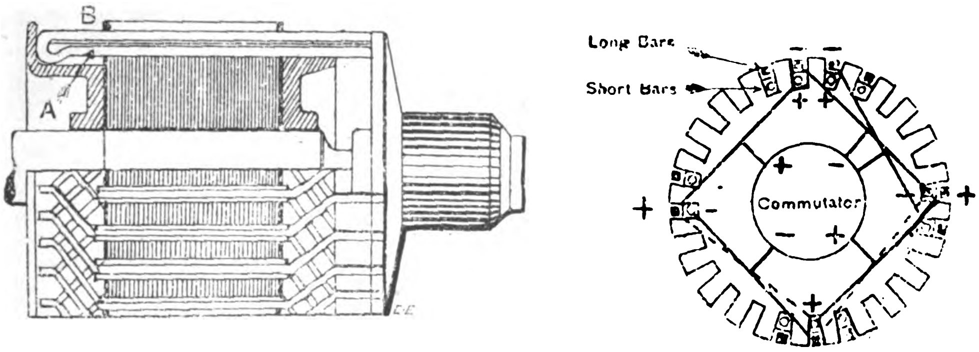
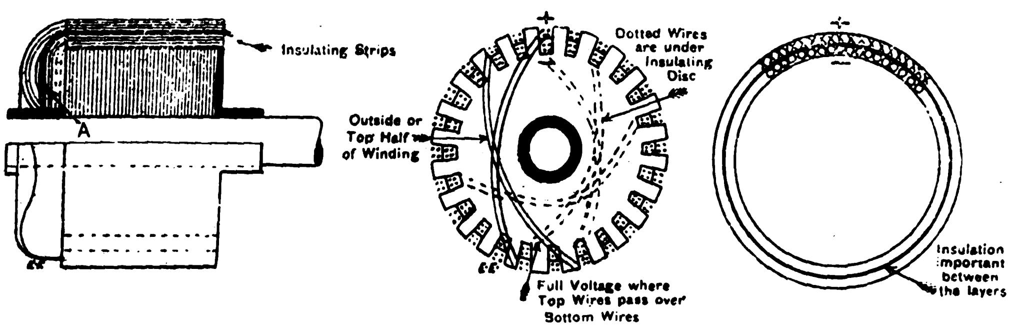


FIG. 3.—FOUR-POLE SLOTTED-CORE BAR ARMATURE WITH BARREL WINDING.

Slotted-Core Drum Armatures.—In slotted-core armatures the full voltage usually occurs between the top and bottom bars in any slot or top group and bottom group of wires. In this method of winding the top and bottom conductors correspond to the long and short bars of a smooth-core armature, and all that has been explained previously in paragraph 5 applies to this type of armature, bearing in mind that the great need for insulation is between top and bottom bars. In four-pole and multipolar armatures it is often more convenient to adopt the so-called "barrel" type of formed coils instead of using separate crossings. When such coils are used, there will be the full voltage between the top part, B, of the barrel end connection and the bottom part, A, at any point close up to the end of the core, these points corresponding to leg A and B of the ordinary crossings. It is most important, therefore, to have a sheet of good insulating material in the space between A and B, espcially close up to the end of the core. Fig. 3 will explain this clearly.

In a wire-wound armature with slotted core great care must be taken with the insulation between the bottom group and top group of wires. The strip of insulating material should project beyond the core at each end, so that it may be bent down to partially cover the wires of the bottom coil in the slot, where they emerge from the core. Some extra insulating material, such as varnished paper or calico, is desirable between each coil on the ends of the armature, but it need only be thin. When the first half of the coils has been wound, both ends of the armature should be thoroughly well insulated before any of the second half is wound, as there will be the full voltage at various points on the ends between the first half and the second half of the winding, in the same way that there is between the inner and outer legs of the "crossings" of bar armatures. In the case of armatures with a double winding and two commutators, the above remarks apply, of course, to each of the windings, and in addition, specially great care must be taken to thoroughly insulate the second winding from the first, both in the slots and on both ends.



Two-Pole Slotted-Core Wire-Wound Drum. A is a disc of insulation put on the ends as soon as one-half the total number of coils has been wound.

Smooth-Core Two-Layer Drum Winding.

FIG 4.

The points mentioned with regard to wire-wound slotted-core armatures apply also to the special form of wire winding sometimes used for smooth-core armatures, where the conductors are all laid round the armature core at the start, while the ends of the armature finally form a sort of hollow cage or barrel. The full difference of potential occurs between the first and second layers in a two-layer winding, due to the method of connecting up, and not between wires side by side as in a bar armature.

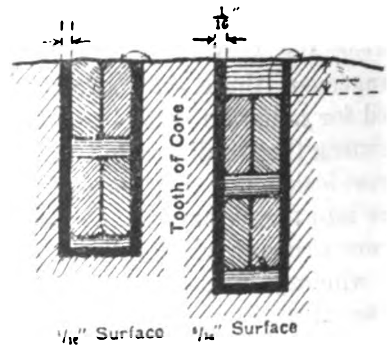


FIG. 5.

A few words on the importance of leaving sufficient surface of insulation for prevention of breakdowns. Although many materials are such good insulators that even very thin pieces will withstand a pressure many times greater than the working voltage, however good the material may be, there is always the danger that an accumulation of moisture or dirt, such as copper or carbon dust, may lead the current across a narrow surface from one place to another, say, for instance, from a long bar to a short bar, and thus a short-circuit, the effect, of course, being quite as bad as though a spark had passed clean through the insulation between them. A reference to Fig. 5 will show exactly what is meant. For an example, a bare copper bar is shown in a slot of an armature, being insulated from the core by a trough of mica, presspahn, or any

suitable material. If this trough is, say, only $\frac{1}{16}$ inch thick, it may take a pressure of thousands of volts to pierce through it, but if the bar is flush with the top of the trough, and a small amount of grease or dust happens to cover the edge of the trough, very likely only a few hundred volts would be sufficient to spark across this $\frac{1}{16}$ inch surface.

Now, suppose that instead of the copper bar being flush with the top of the trough, it is considerably below, say $\frac{1}{4}$ inch, there will now be a total length of service of $\frac{5}{16}$ inch to bridge across with dirt before any harm could result. And as in practice this open top of the trough would be filled in with a tightly fitting strip of insulating material, there would be very little chance of any dirt bridging across. This is the reason for making the strip of mica cloth $\frac{1}{2}$ inch wider than the leg of the crossings in a drum-bar armature, as mentioned previously. This point of "surface leakage" is very important.

In conclusion, it may be once more stated that neglect of these precautions at any single point is certain to result in a breakdown sooner or later. It is hoped that this short paper may be the means of showing workmen the reason why, as well as how, certain things in armature construction are done.

COIL WINDINGS FOR ELECTRICAL PURPOSES.*

BY RICHARD VARLEY AND CHARLES R. UNDERHILL.

The electro magnet as a temporary power transformer has long been in general use for various purposes and has now reached a stage where it can be standardized for performing a certain amount of work through various distances. As there is very little data on the subject and the requirements are so exacting, the practical method of obtaining data is to construct electro magnets of different forms and sizes and make actual tests, and having once found the pull which may be produced through various distances with different magnetizing forces, it is then comparatively easy to determine what size of wire should be used for any given voltage to produce the desired results.

To begin with, the first data usually given is the tractive force, or the amount of pull required. The next is the distance through which this force must act. This gives the total amount of work in foot pounds. The time factor does not enter into the work so much in a case of this kind, but the time that the current is to be left on the winding does determine the size of the winding, particularly the outside diameter, as the winding must have sufficient superficial area to radiate the heat rapidly enough to prevent the winding itself from becoming overheated. If the area is not sufficiently great, the heat will not have sufficient outlet, so to speak, and therefore the winding will get extremely hot, which heating not only raises the resistance of the winding, thereby decreasing the ampere turns for a constant voltage, but it is also liable to damage the insulation, thus causing a short circuit, and, in consequence, a complete burning out of the coil.

In studying the many phases of electro-magnets very interesting points are noticed. For instance, for long ranges the pull will vary almost in direct ratio to the ampere turns, while for short ranges, that is, where there is a short gap in the circuit, the proportionate pull will be much greater for low magnetizing forces than for high magnetizing forces. The reason for this is obvious. In the case of a long range, the iron will not become sufficiently saturated to increase the total reluctance of the magnetic circuit, as the reluctance of the air gap is at least 90 per cent. of the total reluctance. In the case of the short air gap, however, and particularly if the sectional area is great, the reluctance of the gap may not exceed, or in some cases may be less than the reluctance of the iron portion of the magnetic circuit, therefore it is very difficult to make any set rule for determining the pull.

Again, there has been very little data published regarding the coil and plunger type of magnet, or solenoid. General magnetization curves have been shown, but no particular working data given, therefore the manufacturer of electro-magnets has to make a great deal of original research in order to be able to make estimates on electro-magnets specified under many varying conditions. It has been found that by making different sized magnets of various types that a general curve may be drawn by reference to which the proper dimensions may be found for any pull through any range desired.

The data required from customers ordering is as follows:

The pull, whether uniform or accelerating.

The distance through which the pull must act.

The time the current is to be on the magnet, and

The length of time between the contacts operating the magnet.

It should also be specified whether the magnet is to be in a vertical or lateral position, unless the weight of the armature is to be counterbalanced by a weight or spring. When this is not specified, it is customary for the manufacturer to make the pull of the magnet great enough to include the weight of the armature. It is important to know the length of time the current will be on the winding in order to make the radiating surface sufficiently great, and also to know the length of time between the contacts, as the magnet will cool during that time, and so that this may be deducted from the heating.

Again, there is little data given which enables the designer to actually determine just how much a magnet will heat with a given voltage or current, and this again has to be practically determined from actual tests. By these means a standard line of electro-magnets and solenoids has been designed, standard patterns made, etc., which enables the customer to obtain exactly what he wants at market prices, just as he purchases a dynamo or motor.

There is no good reason why the customer should not be able to obtain an electro-magnet to perform any reasonable operation, and this on the open market, just as he would obtain a dynamo or motor.

As an example, let us assume that an electro-magnet is required which will pull 25 pounds through a range of 10 inches.

Now, since the field of the solenoid is nearly uniform throughout its entire length, the solenoid immediately suggests itself for this purpose.

But here the designer lacks data on the relation between the ampere turns in the winding and the necessary diameter of the plunger in order to fulfill the specifications. The practical way out of this difficulty is to make a test. By selecting several lengths of solenoids with different diameters, and by testing these solenoids with various sizes of plungers, excellent data is obtained which helps the designer to determine the proper size of solenoid and plunger for any specific purpose.

It is obvious that an iron-clad solenoid is stronger than the simple type of solenoid, as the iron completes the magnetic circuit. But here again the designer lacks data, and therefore tests must be made before the actual design can be completed.

Again, the plunger electro-magnet is much stronger than the simple or iron-clad solenoid, for short distances, as it has the combined functions of the iron-clad solenoid and the electro magnet, and data has to be obtained for this. So it is for all the different types of electro-magnets. True, we have excellent data for

*Paper read at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

electro-magnets with closed magnetic circuits, but it is a rather difficult undertaking to accurately calculate the action of an electro-magnet when its range of action is comparatively great.

The pull does not vary by any known law, such as the square of the distance, or the cube, for that matter, but the pull is much greater when the air gap is small than when the air gap is great, although in the latter case the pull is more uniform for a given range.

Where the air gap is small, the iron portion of the magnetic circuit may also be short, as less electrical energy is necessary to produce sufficient magneto-motive force to send the required amount of flux across the gap. In all cases the magnetic circuit should be as short and as large as possible in cross section, but for long air gaps much more room is required for the winding necessary to force the lines through the large air gap, i.e., a winding of higher pressure is required, and where the reluctance of the air gap is great the reluctance of the longer iron portion of the magnetic circuit will be negligible by comparison with the reluctance of the gap. The time that the current is to be in the winding also determines the size of the winding, as a winding, which is to be in circuit only momentarily, will not require as much radiating surface, and therefore a much larger wire may also be used, thereby reducing the size of the winding for the same ampere turns.

To the casual observer, the winding of an electro-magnet is the least important of that indispensable detail of so many electrical devices. The magnet circuit is carefully considered, as it should be of course, but the winding is briefly referred to in terms of ampere-turns. This is correct, so far as it goes, but how about the economy of that winding? How shall the winding itself be so constructed that the maximum of magnetic energy in ampere-turns may be obtained with the minimum amount of electrical energy?

The ampere-turns are, of course, dependent upon two things only, namely, the resistance of the average of all the turns in the winding, and the electromotive force applied to the winding.

This rule is based upon the following reasoning: Assume a single layer of insulated wire wound upon a core of any given diameter. Now assume but one turn of wire, with, say, one volt pressure on that turn. If the resistance per turn of wire is .01 ohm, the resultant current would be 100 amperes, therefore for one turn of wire there will be 100 ampere-turns. Now assume two turns of wire with the same total pressure, i. e., one volt. The resistance will then be .02 ohm, and the current 50 amperes. Then 50 amperes and 2 turns equal 100 ampere turns as before. This rule holds the same for any number of turns, only in the practical condition the average diameter of all the turns is taken.

As the current strength for a constant resistance is dependent upon the voltage, in the case just considered the ampere-turns for 10 volts would be 10 times the ampere-turns per volt, or 1,000 ampere-turns. Therefore it will be seen that the ampere-turns, for any specific case in which the voltage and mean diamter of the winding are given, depend entirely upon the resistance of the average turn regardless of any number of turns in the winding.

The economy of the winding for any specified number of ampere-turns depends entirely upon the number of turns in the winding, as the greater the number of turns for the same mean diameter, the greater will be the resistance, and consequently the less will be the current for the same ampere-turns and voltage.

The meaning of this is, that less electrical energy is required to maintain a given magnetizing force in a coil with many turns of a given size of conductor, than with a few turns of the same conductor.

The ideal condition would require a wire whose cross-section should be square or rectangular, and the insulation should be vanishingly thin, that is, the convolutions should be insulated from one another, without any space being occupied by the insulation. The practical conditions, however, are far from being ideal, not only with respect to the exceedingly thin insulation, but also on account of the infeasibility of using wire of square or rectangular cross-section, owing to the perversity of the square wire in endeavoring to rest upon its corners in the winding, instead of upon its flat sides, as is assumed in the idea case, and while the rectangular wire or ribbon answers very well for heavy work, it does not give satisfactory results with wires finer than No. 14, on account of the greater amount of insulation required to cover it for equal cross-sections as compared with round wire and for this reason best results are at the present time obtained with round wire.

The ordinary method of insulating is to wrap cotton or silk about the wire. For all practical conditions cotton is quite as good for insulating as silk, but owing to the greater thickness of the cotton, the silk covered wire winding is more economical as to operation, although a trifle more expensive in first cost.

Let us compare the various weights of copper in the ideal case with the weights of copper in the windings with silk and cotton covered wire.

In the ideal case the winding volume would be entirely filled with copper, while in the practical cases the volume occupied by the insulation as well as the volume lost due to the interstices between the turns of round insulated wire, must be deducted from the total winding volume to give the volume of the copper.

For this purpose let us consider a winding volume of one cubic inch. For the ideal condition, the weight of the copper would be .03 pound, while for a No. 30 B. & S. wire insulated with silk to 2 mils increase, the weight of the copper should be but .175 pound, and for a cotton insulated wire of the same diameter, the increase in diameter, due to the cotton, being 4 mils, the weight of the copper in the winding would be but .129 pound.

It is sometimes desirable to use an insulating material which will not burn when the winding becomes very hot, and asbestos covered wire is used to some extent, especially in arc lamps where the temperature of the controlling magnets is influenced by the heat from the arc, but while this insulation is not inflammable and does not char or crumble, it is so thick that only a small portion of the available winding volume is filled with copper, and for this reason the asbestos insulated wire is not economical, as compared with cotton covered wire.

In the calculation of the proper wire to be used in a given bobbin for any specific purpose, there are two factors which must always be determined. One is the resistance factor and the other the space factor. These two factors may be combined and called the combined space and resistance factor, and expressed in terms of "ohms per cubic inch." Therefore if we know the cubical contents of our bobbin, and have previously calculated a table of "ohms per cubic inch" for the various sizes of insulated wire, we may quickly determine the proper size of wire for our purpose.

Let us consider a round winding. Since the winding on a bobbin of circular section is really a hollow cylinder the volume will be

$$\pi L\left(\frac{D^2 - d^2}{4}\right) \text{ cubic inches.}$$

Where D = outside diameter of winding,
d = inner " " "
L = length " " "

(To be continued.)

THE INSTITUTE BANQUET.

The annual dinner of the American Institute of Electrical Engineers, and the fifty-seventh anniversary of the birth of Thomas A. Edison, called together a large assemblage—nearly 700 persons—at the Waldorf-Astoria last Thursday evening.

The ballroom of the hotel was strung with wires, and telegraph instruments were scattered all over the place. Chief among the decorations was the incandescent light.

The first announcement of the evening was made by President Arnold, who said:

Ladies and Gentlemen: I have the following message from the President: "Thomas A. Edison, Waldorf-Astoria, New York. I congratulate you as one of the Americans to whom America owes much, as one of the men whose life work has tended to give America no small portion of its present position in the international world—Theodore Roosevelt."

The reading of the telegram was received with great applause and a standing toast was drunk to the President of the United States.

President Arnold—In opening the intellectual part of the evening's programme, I cannot perhaps interest you more, and better lay the foundation for what is to follow than by first directing your attention to the objects for which our Institute is organized, the requirements for membership in it, and refer to the achievements of its members in general, for to others fall the pleasanter task of testifying to the specific work of our distinguished guest of honor. (Applause.)

President Arnold then gave a brief history of the Institute, and concluded his address by introducing Mr. T. Commerford Martin, the toastmaster.

Mr. Martin made a felicitous speech and proposed the health of Mr. Edison, which was drunk and cheered, the band playing "For He's a Jolly Good Fellow."

Mr. Edison responded to the toast by telegraph, rapidly ticking out his speech on a Western Union Edison quadruplex, his original invention. It was received at the other end of the banquet table by A. B. Chandler, President of the Postal Telegraph Company on a Postal "quad" and then read amid uproarious applause.

Mr. Edison, while sending his speech, sat with a cigar in his mouth, and was all smiles. The following was his response:

"I want to thank first of all my fellow members ot the American Institute of Electrical Engineers for the great honor done me in thus celebrating my birthday, associated with the twenty-fifth anniversary of the completed development and successful introduction of the incandescent lamp. Your expressions of good will gratify me deeply. While I cannot but rejoice at the place which the incandescent lighting art has made for itself among the inestimable comforts and conveniences of civilization, I feel that my share in the work is exaggerated by this prominence given me to-night.

"To my old friends and associates who have founded the Edison Medal in the Institute I can but extend you thanks again. If I could do it in return I would found a medal for every one of you, for you are just as much entitled to recognition as I am. You gave me your friendship and loyalty, your watchful days of toil and sleepless nights of anxiety. Some of you helped to perfect the art by your engineering skill, your legal ability, your financial aid."

Mr. Samuel Insull, representing the Edison Medal Association, presented to the American Institute of Electrical Engineers, as trustee, the fund raised to found and endow an Edison Medal to go each year to that student in electrical engineering whose thesis or recorded research shall be deemed most worthy of honor.

Happy speeches were made by Dr. Kennelly, Prof. Pritchett and others, and during the evening the telegraph instruments in the banquet hall were kept busy recording messages of congratulation to Mr. Edison from all parts of the world.

PERSONAL MENTION.

Mr. John H. Kelman, formerly superintendent of the Stanley Electric Manufacturing Company in Pittsfield, Mass., has resigned his position to take one with the Allis-Chalmers Company of New York, manufacturers of heavy machinery.

Mr. R. B. Strong and **Mr. A. C. Middleton**, announce that they have formed a co-partnership under the firm name of Strong & Middleton, as consulting electrical engineers, located at 39 Cortlandt street, this city.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEBRUARY 9, 1904.

Electric Railways and Appliances.

751,456. Surface-Cleaning Device for Third Rails of Electric Railways. Milton C. Canfield, Cleveland, O., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Filed Jan. 14, 1903.

751,749. Trolley-Wheel. John E. Palmer, Somerville, Mass. Filed Nov. 14, 1903.

751,835. Electric-Car Truck. Edward Cliff, East Orange, N. J. Filed Nov. 21, 1903.

751,900. Trolley Road-Crossing. James M. Collins, Byesville, O., assignor to Joseph A. Jeffrey, Columbus, O. Filed Feb. 2, 1901. Renewed Sept 9, 1903.

Electric Lights and Appliances.

752,005. Electric-Arc Lamp. Frederick Sindingchristensen, Brooklyn, N. Y., assignor of one-half to Francis F. Storm, Maywood, N. J. Filed Aug. 29, 1902.

Electrical Machinery and Apparatus.

751,440. Commutator-Lead and Mode of Making Same. Charles F. Adams, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Aug. 8, 1903.

751,442. Reverse-Current Cut-Out. Leonard Andrews, Manchester, Eng., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Filed June 25, 1903.

751,474. Pole-Changer for Dynamos. Isidor Deutsch, Montreal, Canada. Filed May 14, 1903.

751,540. Power-Transmitting Mechanism. David L. McClintock, Kansas City, Mo. Filed April 27, 1903.

751,547. Motor-Controller. Francis V. Nicholls, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed June 13, 1903.

751,563. Dynamo-Electric Machine. David B. Rushmore, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed June 26, 1903

751,571. Time-Limit Relay for Electric Circuits. Harve R. Stuart and Arthur B. Reynders, Wilkinsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed April 11, 1903.

751,574. Electric-Spark-Producing Apparatus. Chester H. Thordarson, Chicago, Ill. Filed March 10, 1903.

751,581. Controlling Mechanism for Electric Vehicles, Frank S. Wahl, Buffalo, N. Y. Filed Dec. 21, 1901.

751,595. Parallel-Feeder Protection. Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed July 16, 1903.

751,597. Electric Switch. Gilbert Wright and Harold C. White, Pittsfield, Mass., assignors to the Stanley Electric Manufacturing Company. Filed June 13, 1903.

751,598. Means for Controlling Governor-Motors. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Sept. 24, 1903

751,616. Magneto-Electric Generator. Hugh J. Creighton, Anderson, Ind. Filed May 13, 1903.

751,634. Rheostat. George Graybill and John P. Oden, York, Pa. Filed June 8, 1903.

751,654. Apparatus for the Regulation of Electrical Circuits in Heating Devices. Willie D. Kilroy, Uxbridge, Eng. Filed Oct. 6, 1902.

751,854. Thermostat. George D. Hoffman, Chicago, Ill., assignor to the Norwall Manufacturing Company, same place. Filed May 25, 1903.

751,903. System for the Operation of Electric Motors. Arthur C. Eastwood, Cleveland, O. Filed Sept. 25, 1903.

751,985. Underground-Conduit Insulation. John M. Humiston, Berwyn, Ill. Filed April 27, 1903.

751,991. Current-Director. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company. Filed Jan. 28, 1901.

751,993. Speed-Regulator for Generators. George J. Pelstring, Cincinnati, O., and Henry G. Pelstring, Covington, Ky. Filed May 11, 1903.

752,008. Induction-Coil. Charles F. Splitdorf, New York City. Filed July 15, 1902.

Telephones and Telephone Apparatus

751,501. Electric Telephone. Ernest Gundlach, Western Springs, Ill. Filed Nov. 10, 1902.

751,539. Ringing-Key for Telephone-Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed May 9, 1902.

751,566. Ringing-Key for Telephone-Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company. Filed May 9, 1902.

751,797. Central-Energy Telephone System. John H. Lendi, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Dec. 19, 1900.

751,829. Telephone. Ernest T. Billig, New York City. Filed Dec. 2, 1902.

751,845. Telephonic Repeater. Merritt Gally, Brooklyn, N. Y. Filed April 23, 1903.

Miscellaneous.

751,441. Means for Protection Against Reverse Currents. Leonard Andrews, Manchester, Eng., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Filed June 25, 1903.

751,459. Line-Insulator. Cummings C. Chesney, Pittsfield, Mass. Filed Jan. 14, 1903.

751,460. Lightning-Arrester. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Aug. 8, 1903.

751,549. System of Electrical Distribution. John S. Peck, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed May 1, 1903

751,569. Altiscope or the Like. Lawrence Y. Spear, Greenport, N. Y., assignor to the Electric Boat Company. Filed March 14, 1903.

751,655. Telephony. Isidor Kitsee, Philadelphia, Pa. Filed Jan. 9, 1901.

THE TELEPHONE WORLD.

Independent Telephone Merger in Indiana.

The officials of the 14 Independent telephone companies in Henry County, Ind., recently met in New Castle, for the purpose of perfecting an organization which will have for its purpose the general extension of county lines, mutual benefit, hearty co-operation, and all will unite in an effort to fight competition introduced by the Central Union people. The meeting was held behind closed doors, and the proceedings were not given for publicity.

Telephone Company Gives Free Service in Chicago.

Subscribers to the Illinois Telephone, the new automatic service in the downtown district, have received a pleasant, unusual and unexpected surprise. Official announcement was made by the Illinois Tunnel Company, successors to the telephone corporation, that all bills for past service will be wiped out and that service on the telephones now in use or to be put in will be free up to April 1, 1904.

This action wipes out bills or charges at the rate of 5 cents for every call made since the installation of the system. President Wheeler said in explanation of the announcement:

"We now have almost 5,000 telephones in use and are adding to the number daily. We want to educate the people in this business men's exchange to the great value of the service, and in order to get our subscribers and the public generally to use the telephone freely, we decided to wipe out the charges for all past service over our lines and continue the free service up to April 1, 1904. It is a change of policy inaugurated by the Illinois Tunnel Company, and I believe it is the first time anything of the kind was ever done by a public service corporation in this or any other country."

The stockholders of the Plattsmouth, Neb., Telephone Company held their annual meeting a short time ago and the usual 10 per cent. dividend was declared. The following officers were elected: President, T. A. Parmele; vice-president, C. C. Parmele; secretary, J. N. Wise; treasurer and general manager, T. H. Pollock.

Kansas City, St. Louis and Nevada are to be connected by a telephone line which is being installed by the Kinloch Company of St. Louis. The line is to start from St. Louis, through Nevada to Joplin, thence to Kansas City. Its estimated cost is $1,500 a mile. It will be one of the most expensively equipped in the State.

The Interurban Telephone Exchange Company has filed an amendment to its articles changing its place of business from Holmes City to Alexandria, Minn.

The Baraboo, Wis., Telephone Company, by its president, Charles Gorst, and secretary, August F. Fisher, lately filed an amendment to its articles of incorporation, increasing its capital from $30,000 to $50,000.

The Rollag, Minn., Telephone Company has been organized with a capital of $25,000, to do business in Clay, Wilkin, Becker and Otter Tail Counties.

Organizing to Fight the Bell Company.

E. M. Cranford of the firm of Cranford Mercantile Company is about to organize a company, with a capital stock of $2,500, for the purpose of putting in a telephone system at Jasper, Ala. The name of this new corporation will be the Home Telephone Company, and the subscribers to the capital stock will be local business men. Mr. Cranford has met with much encouragement and there is little doubt that the company will be incorporated within a short while.

The Southern Bell Company recently acquired possession of the properties of the Jasper Telephone Company, and it was believed that the rates charged for instruments would be reduced, prices hitherto having been considered excessive. But no reduction has been made in the rates, and it is chiefly for this reason that the new company is being organized. It is the aim of the new company to fix the price for its instruments in residences at $1 per month and for business houses and offices at $1.50 per month, which is exactly one-half the amount charged by the Bell Company.

The enterprise is meeting with the approval of many of Jasper's citizens, who express themselves as willing to subscribe liberally to the movement.

Ohio Telephone Deal.

A deal was completed in Cleveland last week whereby the Federal Telephone Company sold all its interest in the Citizens' Telephone Company of Columbus, O., to a syndicate headed by Cyrus Huling of the latter city. The price at which the transfer was made has not been made public, but it is known that there changed hands 3,354 shares of stock with a par value of $100. The total issue of stock was $750,000. The Columbus people bought control of the company from the Federal Telephone Company a year ago and now have completed the purchase of the stock, having it all in their hands.

The annual meeting and election of officers of the Orange and Sussex Independent Telephone Association was recently held in Middleton, N. Y. The several local telephone companies comprising the Association were represented as follows: Warwick Valley, Farmers, Highlands, Chester, Sussex, Colonial, and Orange County. The officers elected were: President, George G. Otis, of Newburgh; vice-president, George F. Ketchum, of Warwick; secretary, Mott C. Tuthill, of Washingtonville; treasurer, W. D. Haggerty, of Sussex.

The Schenectady, N. Y., Railway Company will shortly install a system of telephones on its Troy and Albany interurban lines. These telephones will be placed in the cars running on these divisions, and they will be so arranged that communication may be held with the office in Schenectady at any point along the tracks.

The Charleroi, Pa., Telephone Company has applied for rights of way through Charleroi and the petition will be acted upon at the next meeting of the council. The company was formed by local men last December and has 125 subscribers.

Signs of Telephone War.

A lively telephone war seems imminent in Shelby County, Ia. The Bell Company has been supplanted for all but long distance service by the Harlan & Avoca Company, an Independent company. In the east part of the county, however, three or four farmers' mutual lines have been in process of building, and, indeed, in use over a limited territory. These lines for some time have been endeavoring to secure what they thought would be reasonable rates for connection at Harlan with the Harlan & Avoca Company. Failing in this, about a dozen representative farmers recently appeared before the Harlan city council and presented a written petition backed up by oral argument for a franchise allowing them to come into Harlan. The farmers offered to pay the expenses incident to the submission of the proposition to the people. The city council passed a resolution providing for the submitting of the question next spring at the regular election. The farmers' lines have several hundred 'phones in operation, and they will wield a large amount of influence with residents of Harlan.

At a recent meeting of the grocers and butchers of Clare, Mich., it was decided to throw out all Bell 'phones and use the Union or Independent 'phone exclusively. This is counted as quite a successful outcome of the Independent and Bell Companies' fight that has been put up in Clare during the past week, although the movement started by the merchants in that city was voluntary without any agitation on the part of the telephone companies.

Telephones were lately installed in Missouri on the cars of the suburban divisions of the East St. Louis & Suburban Electric Railway, which permits the street car employes to connect with the power house or the general superintendent's residence from any point along the lines. The system is arranged so that on every 15th pole there are connections into which are placed the wires of the telephones, which are carried on the cars.

Arrangements are being made by the People's Telephone Company of Wayne, Mich., for an extension of the line from Carleton to Stoney Creek, about three miles southwest of Carleton, then to make connections with the line running to Scofield.

The Pittsburg & Allegheny Telephone Company is to adopt the automatic system in McKeesport, Pa., and has just completed arrangements for adding about 5,000 subscribers to its list by connecting with the National Telephone Company of Wheeling, W. Va.

Telephone Incorporations.

The Consolidated Telephone Directory Company, Cleveland, O. Capital stock, $15,000. Incorporators; C. I. Werlenbaker, B. F. Bellows, J. B. Beardsley, V. F. Bellows and L. N. Wertenbaker.

The Kelsey Telephone Company, Kelsey, N. Y. Capital stock, $2,000. Incorporators: George Webster, Anna Thompson and J. H Alexander.

The Atwater Telephone Company, Atwater, Minn. Capital stock. $10,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albuquerque, N. M.—It is understood that the Santa Fe Company will overhaul its electrical plant in this city.

Benton Harbor, Mich.—The council has closed a contract with the Benton Harbor & St. Joseph Electric Light Company for lighting a certain part of this city for a term of years.

Burlington Junction, Mo.—Robert Crooks contemplates the erection of an electric light plant here.

Cloverport, Ky.—The city clerk has been ordered to advertise for bids for electric lights in this city.

Dayton, Tenn.—A proposition to establish an electric light and waterworks plant is being considered by the mayor and board of aldermen of this city.

Dewitt, Ia.—The Dewitt Electric Light Company will expend several thousand dollars in improvements.

Dyersville, Ia.—The Dyersville electric light plant has been sold to Eastern capitalists, who will enlarge the plant.

Ellensburg, Wash.—A recent election here resulted in favor of issuing $20,000 worth of bonds for the purpose of constructing an electric light plant.

Ft. Worth, Tex.—George F. Majars and T. A. Holdes, local capitalists, are preparing to erect an electric light plant here.

Georgetown, Ill.—The village board has granted a franchise for the electric light plant for this village, which must be completed within nine months.

Henderson, Tenn.—The local electric plant has been purchased by a Mr. Dalton of Huntingdon, Tenn., who will reconstruct it.

Hope, N. J.—There is some talk of an electric light plant for this place.

Hopkins, Mo.—C. M. Hartness is figuring on the cost of an electric light plant for this place.

La Farge, Wis.—The La Farge Electric Company has been incorporated to erect an electric light plant here. Its capital stock is $6,000. James Dinsdale, James O. Davidson and B. C. Rosencrans are the incorporators.

Lincoln, Ill.—Articles of incorporation for a company which proposes to establish a plant for furnishing gas and electricity in competition to the present company are stated to have been drawn up. Walter J. Lamb is interested.

McGregor, Ia.—The electric light plant, which was recently destroyed by fire with a loss of $11,000, will be rebuilt.

Milwaukee, Wis.—Extensive improvements will be made by the Milwaukee Electric Light Company and the Milwaukee Light, Heat & Traction Company this year. Improvements will cost about $200,000.

Morelos, Mex.—Steps are being taken to establish an electric lighting plant in the town of Tancitaro near this city.

Neenah, Wis.—The Wisconsin Heat, Traction, Light & Power Company, operating an electric line between here and Kaukauna, has petitioned the council for a franchise to light the city.

New Haven, Ind.—Town Trustees Clark and Schnitker are agitating the installation of a municipal electric light plant.

Newton, Miss.—A company is being organized here with a capital of $100,000 to build a cotton oil mill, fertilizer factory, waterworks and electric light plant.

Penn Yan, N. Y.—The installation of a new municipal electric light plant here is being considered.

Piper City, Ill.—The farmers around here want electric lights.

Stanberry, Mo.—The Stanberry Electric Light Company has been incorporated with a capital of $25,000. The directors are J. T. Norman, A. C. Frisbie and others.

St. Augustine, Fla.—The installation of an electric light plant here is being discussed.

Troy, O.—The local business men are tired of the present inadequate electric light meter system and will erect an electric light plant of their own.

Watseka, Ill.—The electric street lighting contract with the city will expire October 1, 1904, and sealed bids will be received by the city for a new contract therefor until March 15. Address C. L. Abell, city clerk.

Wessington Springs, S. D.—Mr. Savage, of St. Paul, is here making arrangements with a local electric light company for putting in electric lights in this place.

Xenia, O.—D. M. Stewart and Charles Darlington are reported as interested in the formation of a new company for electric lighting.

STREET RAILWAYS.

Augusta, Me.—The Northern Maine Seaport Company, which proposes to build a line from La Grange to Belfast, has filed articles of association with the Secretary of State. The proposed road, which will be operated by electricity, will be 60 miles in length and will connect the Bangor & Aroostook with the Belfast branch of the Maine Central, traversing a territory not now supplied with railroad facilities. The company is capitalized at $360,000.

Canton, O.—John C. Welty, local counsel for the Tucker-Anthony Syndicate, owners of the Canton-Akron and allied electric and suburban lines, said that an electric line from Cleveland and Columbus is now an assured project.

Cincinnati, O.—Judge A. S. Berry is booming a scheme of an interurban electric road from Alexandria, Ky., to this city.

Clarksville, Ind.—A franchise has been granted to Peter Arland & Co., for a new electric line here.

Euclid, O.—At the meeting of the village council at Euclid Heights it was decided to advertise for bids for the construction of an electric line through a certain part of the village.

Harrisburg, Ill.—The Illinois & Kentucky Railway Company was lately granted a franchise to construct and operate an electric railroad over the highways in Saline County.

Hudson, N. Y.—The prospects are brighter for the construction of an electric road from here to Lee, Mass., or some other point in that State, where connections could be made with the electric roads which extend east and south through Connecticut and on to New York City.

La Fayette, Ind.—Next summer an electric railroad from here will enter Kankakee County, Ill.

Leon, Mex.—An electric traction system is projected in this city in the State of Guanajuato. Power will be derived from the Guanajuato Electric Light & Power Company, of which Henry Hine is president. Americans propose to build the system. H. F. Gornford of San Francisco, Cal., has gone to Mexico for the purpose of investigating the proposition.

Marinette, Wis.—H. C. Higgins, a Dixon, Ill., capitalist and former president and manager of the local street railway, says he is still considering the possibility of building a trolley line between Peshtigo and this city, for which he holds a franchise. Mr. Higgins is one of the owners of the Manitowoc-Two Rivers trolley line.

Minneapolis, Minn.—The Minnesota Central Railway Company is being organized by capitalists of this city to build an electric line from St. Paul to Duluth.

New York City.—Last week the aldermen granted to the New York, Westchester & Boston Railroad Company permission to cross 68 streets of the Bronx, below or above grade, with its proposed electric railroad from the Harlem River.

Ottawa, Ont.—General Manager Gay has confirmed the rumor to the effect that the Ottawa & New York Railway is to be operated by electricity, the change in the method of propulsion taking place during the present year. Electric engines are to be used, the power to be supplied from Ottawa, Cornwall and Massena Springs. It is anticipated that a saving in time and cost of operation will thus be effected.

Philadelphia, Pa.—It is stated that the Pottstown & Westchester Electric Railway Company, of which Winslow Mason is president, and S. M. Godfrey is secretary and treasurer, will build a 22-mile trolley between the places named, and thereby will complete a line from this city to Reading.

Port Washington, N. Y.—A representative of the Mineola-Roslyn-Port Washington Traction Company has been here lately settling all arrangements for the right of way with various land owners. It is the intention of the company to begin the construction of the road as soon as the frost is out of the ground. According to the terms of the franchise the trolley must be in operation not later than June 1.

Salt Lake City, Utah.—J. J. Burns, in conjunction with local capitalists, will build an electric road between here and Ogden.

Sharon, Pa.—The Cleveland & Detroit Navigation Company will furnish the capital for building an air-line electric railway from Cleveland to this city. The line is to be built across the country. The company expects to carry on an extensive freight business. Construction will begin the coming spring, The line will be 80 miles long.

POWER PLANTS.

Columbia, Tenn.—The Louisville & Nashville Railroad Company intends to build a large power plant and electric light plant at Bigby Creek just outside the suburbs of this city. The expenditures involved will be in the neighborhood of $12,000 to $15,000.

Kankakee, Ill.—The Kankakee Electric Railway will build a new power plant.

Lorain, O.—The Citizens' Gas & Electric Company will erect a new power plant here.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12¼@12½c.; Lake 12⅝@12⅝c.; casting, 12¼@12⅜c.

A London cable states that the copper market abroad is strong especially for electrolytic.

On Wednesday last Phelps, Dodge & Co. sold 1,000,000 pounds of electrolytic copper at 12¼c. a pound.

The American Railways Company (Philadelphia) has declared the regular quarterly dividend of 1½ per cent., payable March 15.

The stockholders of the Central District & Printing Telegraph Company, Pittsburg, have voted to increase the capital stock of the company from $10,000,000 to $15,000,000.

The Butte (Mont.) Electric & Power Company has declared a dividend of $1.50 a share on the common stock, payable March 15 to stock of record March 12.

The receivers of the Chicago Union Traction Company have borrowed $50,000 to pay the February interest on the underlying bonds of the Chicago Consolidated Traction system.

Application has been made to the New York Stock Exchange by the Brooklyn Rapid Transit Company to list $5,000,000 first refunding mortgage 4 per cent. coupon bonds of 2002.

The Canadian General Electric Company has secured a contract from the Toronto Electric Light Company for a 5,000 hp. plant. The equipment will include two 2,500 hp. Curtis turbines.

The independent telephone companies of Northern & Middle Vermont have decided to establish a trunk line from St. Johnsbury to Montpelier, thus coming into direct opposition with the New England Telephone & Telegraph Company.

The Poly Phase Ingnition System Company of New York, to manfacture electrical machinery, was incorporated at Albany on Monday. The directors are R. L. Heitzemeyer of Hoboken, N. J., G. G. Schreiber and W. R. Symmes of New York.

Stockholders of the Seaboard Air Line met in Petersburg, Va., last week, and formally ratified the loan from Thomas F. Ryan and others of $5,000,000. The meeting was the last of the formalities necessary to accept and put in operation the loan which is now effected.

The creditors of the Worcester & Southbridge (Mass.) Street Railway Company were paid by check on Monday on the 50 per cent. basis. The road will soon be sold by auction and will be incorporated under the name of Worcester, Southbridge & Sturbridge Street Railway Company with a capital of $700,000.

The Western Electric Company reports making gross sales for the year ended November 30 last of $30,250,000 against $28,626,000 for the same period in 1902. Net earnings for the year ended November 30 last aggregated $2,760,000 and dividends amounted to $920,000. The company's surplus on November 30, 1903, was $8,970,000.

If the plan, now in contemplation by the directors of the United Traction Company of Albany, N. Y., is adopted, $1,339,300 will be used for extensions and improvement of the company's lines. In view of the repeated rumors about the probability of the company purchasing one or more of the suburban lines running into Albany, this large appropriation for the purpose of extending its lines seems to be insignificant.

ELECTRICAL STOCK QUOTATIONS.

Name.	Closing price Feb. 15
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	1427¾
Metropolitan Street Railway	117⅝
Metropolitan Securities	87½
Ninth Avenue	200
Third Avenue	119½
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	235
Brooklyn Rapid Transit	43½
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	64
Philadelphia Traction	97¼
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	140
West End Street, com	90½
do. do. do. pref	109
Chicago.	
City Railway	165
North Chicago	87
Union Traction, com	5
do. do. pref	30
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	21
do. do. pref	47
Electric Lead Reduction	⅞
Electric Vehicle, com	9
do. do. pref	12
Westinghouse, com	160¼
do. pref	194
General Electric	166⅕
Boston.	
Edison Electric Illuminating	235
General Electric	165½
Massachusetts Electric Companies, com	21
do. do. do. pref	78
Westinghouse Electric & Mfg., com	79
do. do. do. pref	90
Chicago.	
Chicago Edison	152½
National Carbon, com	25
do. do. pref	94
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	55
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	123
Western Telephone Company	11
New England Telephone Company	120
New York.	
American Telegraph & Cable Company	84¾
Commercial Cable Company	191½
Mexican Telephone Company	2
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	87½
Miscellaneous.	
Chicago Telephone Company	120
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	27½
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

"Electricity's" Suggestions to be Carried Out.

In the issue of ELECTRICITY of August 1, 1900, shortly after the Hoboken fire, there appeared an article strongly advocating the use of salt water for extinguishing fires. This water and necessary pressure, the article explained, could be obtained by means of electrically-operated pumps driven by surplus electric light and street railway current.

It is good news to hear that the suggestion which appeared in this journal is now advocated by the Mayor of Greater New York and unless side-tracked will in all probability be adopted in the near future.

The Mayor's suggestion, which is heartily indorsed by the Board of Fire Underwriters, is that large mains be established throughout Manhattan, south of Forty-second street independent of the Croton water mains, these mains to be connected with electric pumping plants at various places in the business districts, the pumping plants to obtain the necessary current when need be from the power houses of the elevated and surface roads. It is pointed out that after the cost of installation of such a system the item of maintenance would be very small.

It is to be hoped the plan as outlined by the Mayor will be carried out, as it would effectually insure this city against such a conflagration as recently swept Baltimore. With the North and East Rivers to draw upon for water there would be no possibility of a shortage, whereas in case of a large fire Croton water might give out. Electrically-operated pumps could be started up almost instantaneously, whereas pumps operated by steam engines would require time. The Mayor's idea is a good one, and although it may cost some money to carry out, the system when completed will be more than worth it as a means of protection to lives and property.

* * *

Electrical Discharges to Dissipate Fog.

The United States Consul General, Richard Guenther, at Frankfort, has recently sent to the Department of Commerce and Labor at Washington a translation of an article which appeared in a German paper referring to the dissipation of fog by means of electricity.

The article refers to a lecture delivered recently by Sir Oliver Lodge before the Physical Society of London. It says:

"The great physicist Tyndall had demonstrated decades ago that a heated body, if brought into a lighted atmosphere laden with dust, dispels the dust in its nearest environment and forms a dark space around itself.

"Tyndall thought that the hot body consumed or burned the dust, in his experiment, an organic one, with coal dust.

"Twenty years ago Prof. Lodge resumed the investigations of the same subject jointly with the physicist Clark, and soon found that the explanation surmised by Tyndall was incorrect. It was found that a sort of bombardment emanated from the heated body, which kept the dust at a certain distance.

"Lodge made the still more important discovery that if he employed electricity in place of heat the dust particles acquired a polarity for forming into balls, and were thrown against the walls of the vessel in which the experiments were made. In his experiments he did not use coal dust or smoke, but an inorganic dust, namely, finely powdered magnesia. For the heated or afterward electrified body he used a wire.

"Two pieces of wire netting which were connected with the ends of an electrifying machine were put up opposite each other in a room, through which a slow current of smoke passed. After the wire nets had been electrified the current of the smoke ceased; the particles of dust balled together were driven to the wall of the room and fell to the floor. If steam was introduced instead of smoke it was converted into fine rain.

"This latter result led Prof. Lodge to several conclusions. First, it almost showed by itself how rain was formed from the clouds through electrization, a fact for which, even if it had been surmised, every proof was lacking. Furthermore, Lodge concluded it would be possible to dispel a fog cloud by electricity.

"He made his first fog-dispelling experiment at Liverpool, where he was lecturing as professor of physics.

"During a thick fog the air about the university was electrified by means of a large Wimshurst machine, the current passing through a bunch of points on top of a high mast erected on the roof of the building. In this manner it was spread as much as possible. The result was that for a radius of from 165 to 200 feet the air was perfectly clear—that is free from fog.

"At that time the scientist conceived the plan for a trial on a large scale by placing a sufficient number of stations on both sides of the Mersey and charging the air on one side with postive and on the other side with negative electricity, in order to see whether a mass of fog on the river, which almost regularly caused collisions of vessels and heavy damages in consequence, could not be dispelled.

"Although the practical benefit was apparent, Prof. Lodge did not meet with sufficient support, and his experiment had to be abandoned for lack of funds."

In the issue of ELECTRICITY of September 7, 1898, there appeared an editorial on this same subject, referring in part to an article which appeared about that time in the *North American Review* by Mr. Alexander McAdie, who strongly advocated the dispelling of fog by means of electrical discharges. That nothing practical has been accomplished during the past five or six years in this line is probably due, as intimated in the German article, to lack of funds. That money is not forthcoming for experiments in dissipating fog on a large scale is to be regretted, as the solution of probably no other problem would be more conducive to the welfare and safety of mankind. Many fatal accidents at sea and on land occur through fog, and now that there is a chance of the evil being remedied, it is to be hoped some rich philanthropist will come forward and donate a fund for this purpose.

* * *

Radium Rays and Photography.

The photographic action of radium rays was the subject of a paper recently read before the Physical Society of London. It is well known that a photographic plate by exposure to radium rays is affected in such a way that the plate develops similarly to its development after exposure to light. The experiments described in the paper are an attempt to answer the question: Are the actions the same? As far as can be seen, the final results of the actions and developments are the same, and the experiments appear to indicate that only slight differences occur in the early stages. The plates, suitably inclosed, were subjected to the rays from varying quantities of radium bromide for varying times, and the results showed that the intensity of the developed image increased rapidly to a maximum value with increase of exposure, then decreased first rapidly, and finally very slowly until a stage was reached in which there was practically no dark image formed on development. It is found that spark images are at first obliterated by radium rays which do not cause such a great density as that of the spark images obliterated, and that with prolonged exposure the radium rays reverse the spark images.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Work to aid miners in locating radium in America has begun in the Ryerson Physical Laboratory at the University of Chicago, under the direction of Prof. Robert A. Milliken.

Wm. J. Chalmers, vice-president of the Allis-Chalmers Company, states that the company has formed a coalition with several important English and European manufacturing concerns, under the name of the Turbine Advisory Council, thereby practically doubling the industrial activity of his company. The new departure will comprise the manufacture of steam turbines, hydraulic machinery, gas engines and electrical machinery.

Chief Engineer William Barclay Parsons, of the Rapid Transit Commission of New York, has been invited by the Royal Commission on London Traffic to visit England to testify before that body upon traffic problems. It is said that Mr. Parsons has decided to go, and during his absence the subway work will be in charge of Assistant Engineer George L. Rice.

A bill is before the New York Legislature providing for enlistment of five technical expert civilian electricians as engineers of heavy artillery, National Guard State of New York, for service in coast defenses. It has passed in the lower house with a fair chance, if pushed, of passing the State Senate and becoming a law.

On April 30 from the top of the Washington Monument it is expected that President Roosevelt will send a wireless telegram declaring the gates of the World's Fair at St. Louis open, when President Francis, on one of the towers of the Administration Building, will press the button putting in motion 40,000 hp. units of electrical energy.

President Candamo, in the presence of 3,000 spectators, last week formally opened the electric railway between Lima and Chorillos, South America. The stations and cars were brilliantly lighted.

A foreign contemporary states that the officials of the Paris Metropolitan Railway have decided to abandon the use of power cables carrying large currents through the train and are about to install one hundred complete equipments of the electro-pneumatic turret-type control apparatus to replace the present system. One of the chief features of the electro-pneumatic control system is that compressed air is employed for actuating the controllers on all motor cars, and that the control is effected by very small currents in wires throughout the train at the harmless pressure of 14 volts.

Engineers are already making a survey of the Central-Hudson tracks between Schenectady and Hoffmans, N. Y., which will be graded and put in the finest condition for the third-rail system speed tests. It is expected that all transportation records will be beaten, and that the experiments will commence in the early spring.

Commissioner General Alexandrovsky has officially announced the abandonment of the proposed participation of Russia in the St. Louis Exposition, and it is now stated that Mr. Hajimeota, assistant commisioner general from Japan, has announced that every foot of exhibit space that is given up by Russia will be applied for by Japan.

SIEMENS & HALSKE PRINTING-TELEGRAPH CENTRAL STATION IN BERLIN.

BY FRANK C. PERKINS.

The printing-telegraph central station in Berlin, Germany, is equipped with the type-printing telegraph system of Siemens & Halske Actien-Gesellschaft in connection with the telephone service of the city which has about 70,000 subscribers. The illustration, Fig. 1, shows one of the machines which is used as either a transmitter or receiver, as well as two group switches. In Fig. 2 may be seen the printing-telegraph station, while Fig. 3 is a view of the printing telegraph. It will be noted that there are four rows of keys with seven in each row making a total of 28 in all. All but two of these keys serve the letters, figures and punctuation marks, the letters being transmitted by moving the letter shift key, and the figures and punctuation marks by moving the figure shift key, which displaces the type wheel automatically on its shaft so as to bring the circular row of figures or punctuation marks above the printing surface of the paper ribbon. Then by moving a key for a certain figure, the type wheel is rotated and brings the desired type with that figure in front of the paper, which is pressed against the type wheel, printing the figure and is returned downward quickly, ready to receive the next figure or punctuation mark. For writing the letters the letter shift key is first moved and then any of the keys of the letters desired.

One of these machines is used as a transmitter at one central station and another of the same type as a receiver at the other station. The moving of a given key on one machine causes a corresponding movement at the receiving station, regardless of whether an operator is at hand or not. If no one is at hand at the receiving machine the message is printed on the paper ribbon and may be read later.

It will be noted that with this German apparatus a copy of the telegram is made upon paper by both the transmitting and the receiving instruments which may be kept as records. In the various large cities in America as well as in Europe printing telegraph systems have been in operation for some time where a large number of receiving instruments have been controlled from one transmitter in a central station, supplying reports from stock exchanges as well as other news. A storage battery of 12 cells is used as a working battery, only 12 volts being employed on the line circuit and only one-half of the battery being employed at a time.

The German printing telegraph shown in the accompanying illustration is somewhat similar in operation to the Baudot & Hughes type printing machines. The into the printing circuit and the relays of the instruments and both the receiving and the transmitting machines are energized by local currents. These local currents cause the type wheel to rotate by means of the relay magnets through the

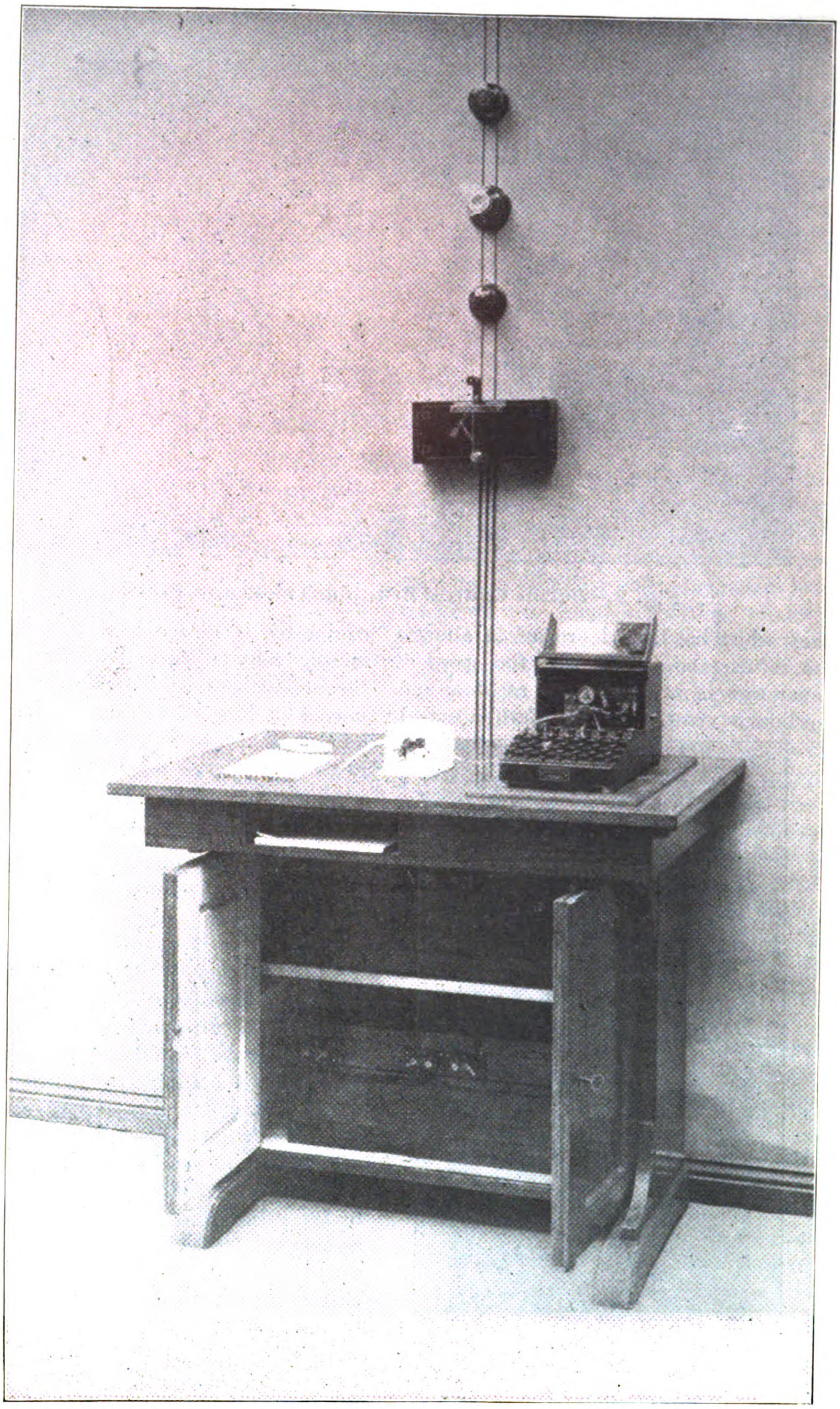

Fig. 1.—Siemens & Halske Printing-Telegraph Instrument and Two Group Switches.

circuit of the transmitting apparatus is closed when the key of a certain letter or figure is pressed, and a switching roller is rotated. Electric currents are thus sent same distance in all the receiving instruments. If a figure key is moved a projection on one end of the lever strikes against the switching inking roller which

is rotating and stops it as well as the type wheel. The type levers of both machines are attracted at the same time and the proper figure will thus be printed. The type wheel can only move again when the scriber presses his calling key, and he is placed in communication with the party desired, by the operator in charge who obtains this information by an inquiring apparatus reserved for the purpose. The

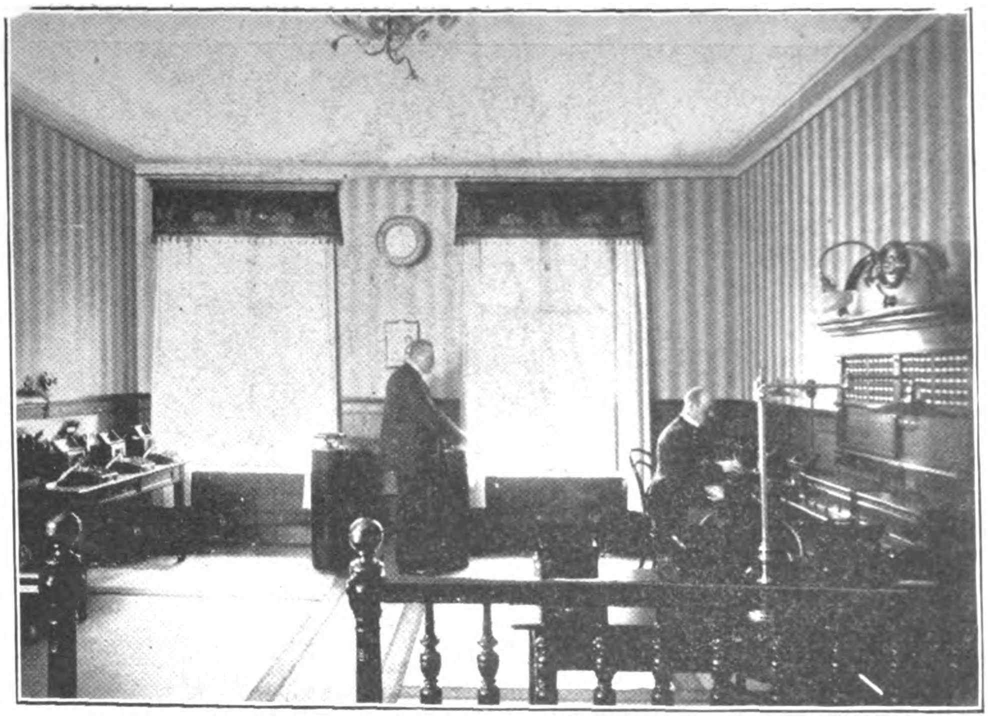

Fig. 2.—Berlin Central Printing-Telegraph Station.

key which has been depressed is allowed to return, and it is stated the speed of operation is practically as rapid as an ordinary typewriter. The Berlin Central

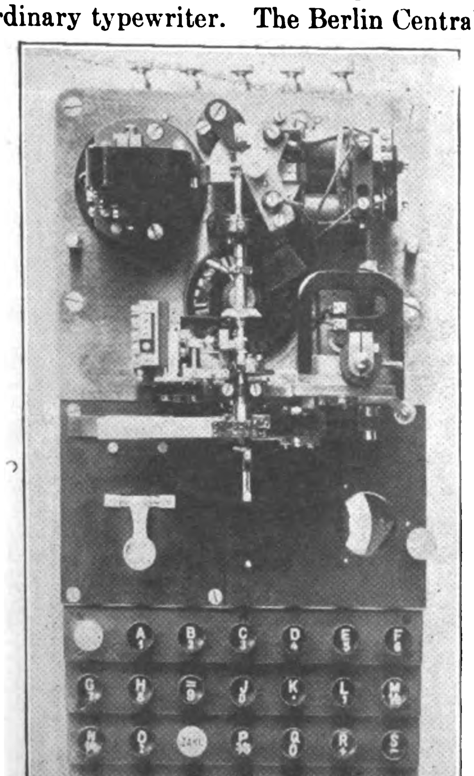

Fig. 3.—Siemens & Halske Type-Printing Machine.

Station is provided with a switchboard somewhat similar to telephone central stations with indicators for a large number of subscribers. An indicator drop falls and a bell rings as soon as any subscriber presses his calling key, and he is placed in communication with the party desired, by the operator in charge who obtains this information by an inquiring apparatus reserved for the purpose. The equipment is so arranged that the same message may be sent simultaneously to all the subscribers, as "tickers" are employed in New York, London and other cities, and also for supplying news items to all of the large newspaper plants for publication.

THE EXCITATION OF ALTERNATORS.*

BY F. H. DAVIES.

The excitation of alternators may be effected in three ways—viz., by aid of a small direct current dynamo coupled to each separate alternator shaft either rigidly or by belting; by independently-driven dynamos, sometimes combined with battery plants and used for exciting all the fields in parallel; or by variations of either of the above methods—effected by the aid of sundry connections that will be shown later—which cause the alternator to become to a certain extent self-exciting, and able to automatically compensate for variations in load in a manner similar to the compound-wound direct-current dynamo, or, in addition to this, to also compensate for variations in power factor.

The first method is, perhaps, the oldest, and has a few points that commend it, notably those of low first cost and compactness, and for these reasons it is still very greatly employed where capital and space are considerations. As regards efficiency in working, however, there are one or two defects in this system that show up both when the alternator thus excited is running singly and when in parallel with others. In the former case the voltage regulation is apt to be very bad, owing to the speed of the engine affecting both the alternator and its exciter in a like manner. If through any cause, such as a sudden increase of load, the speed drops, the alternator volts naturally drop also, both owing to the reduction in speed and the increased load; with separate excitation the matter would end here, but under this system such is not the case; the reduced speed also lowers the EMF. of the exciter, which now, of course, passes less current through the alternator field, and the consequence is a very bad drop in volts for a comparatively small decrease in speed. The converse of this is naturally true, as a small increase in engine speed produces a disproportionate rise of pressure in the alternator. The voltage regulation in an alternating-current station is always more or less of a trouble, but with this system it at times amounts to a positive nuisance if the steam pressure or load is at all variable.

This method of excitation also lends itself to satisfactory regulation when working in parallel; it means that the field rheostat of each machine must be moved separately, thus running the risk of setting up an idle and wasteful current between the alternators owing to the difference in pressure at their terminals, or, that all the regulating switches must be geared together by some more or less clumsy arrangement, the scope of which is necessarily limited to a few machines by the strength of the man that has to operate it. Modern practice confines this method to small installations, anything large being carried out upon the lines of the second one mentioned—viz., that of independently-driven exciting plant. In this system two or more separate direct current sets supply current at the right voltage to a pair of exciter 'bus bars, from which cables are led to the field switch, regulating resistance, and field coils of each alternator. The great advantage is good voltage regulation, seeing that the exciter volts are constant and small speed or load variations do not tell much upon the alternator volts. Regulation in parallel is also greatly facilitated, as it is only necessary to move one small rheostat—viz., that in the exciter field circuit—to affect equally all the machines running. It has been urged against this system that it is equivalent to

*From the "Electrical Engineer," London.

putting all one's eggs into one basket, and that the entire safety of the station depends upon one exciter that may easily go wrong. This is quite true—such events have happened more than once, but the risk is one of those we have to take owing to the advantages that go hand in hand with it. As a matter of fact, this difficulty is easily overcome by the installation of an exciter battery working in parallel with the steam sets; indeed, such an arrangement is absolutely the safest that can be devised. It appears upon the face of it that much cannot be said for its economy owing to the loss in the battery, but this is, at any rate to a great extent, made up for by the fact that the exciters are only run for a short period, at full load and maximum efficiency, as opposed to a 24-hour run most of the time at practically no load, and, therefore, at great loss.

It is also a consideration that the exciters can be shut down at the heavy load, when steam is sometimes scarce, and the charging done either during the day or night watches.

A point to be noted when working with accumulators as exciters, and one that constitutes practically the only inconvenience, is that the usual two-volt step is rather too rough for nice regulation; it consequently has to be taken up to a certain extent on the alternator field resistances. As pointed out before in the hands of a careless or incompetent switchboard attendant, this may lead to the setting up of wastful local currents; and to obviate this, it has in cases been found necessary to provide an additional and separate resistance for each machine, capable when all in of absorbing two volts, and mechanically coupled in suchwise that one turn of a large handle will either cut it in or out in all the alternator fields at once. This should not be confounded with the other coupling arrangement mentioned, which applied to the mechanical connection of the ordinary field-regulating resistances.

The third system of excitation, as stated, is capable of sub-division under two heads —the arrangement that renders the alternator automatically compensating for variations in load but takes no account of alterations in power factor, and the more modern method that does both. The former, originally devised by Prof. Elihu Thomson, is shown diagrammatically in Fig. 1. A is a single-phase, eight-pole alternator, and six of the poles are excited in the ordinary way by a small direct current machine, E. The shaft, S, is fitted with the two slip rings necessary for conveying the exciting current to the revolving magnets, and a commutator of as many segments as there are poles in the field.

In the main circuit of the alternator,

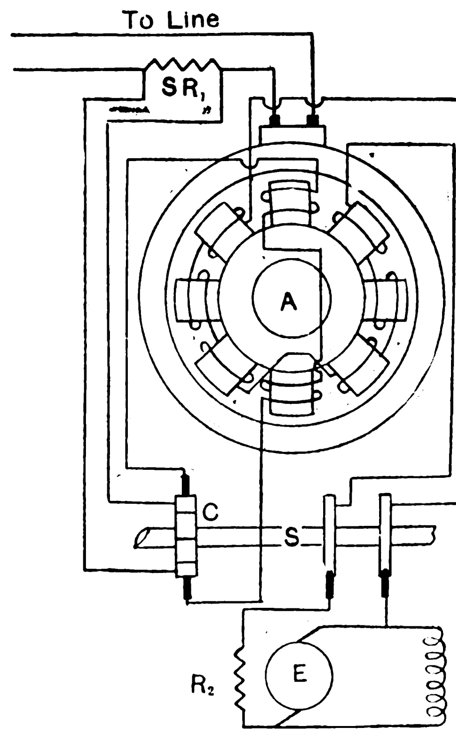

FIG. 1.

shown at the top of the figure, is a low resistance, $S R_1$, from the two ends of which wires are taken to the commutator segments, placing the commutator as a whole in shunt to the resistance; the brushes in contact with the commutator are connected to the windings of any two diagrammatically opposite poles, as shown. By this arrangement the alternator is compounded—that is to say, its

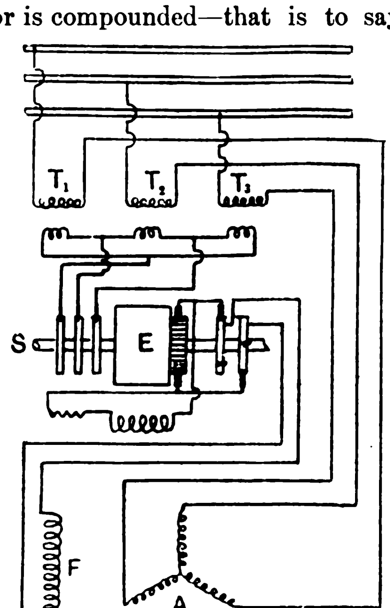

FIG. 2.

voltage will remain more or less constant with a rising or falling load. The action is as follows: The greater the current generated by the machine, the greater the drop in volts over R_1, therefore the larger the proportion of current that flows to the rectifying commutator, and thence round the windings of the two poles, adapted for that purpose. This, of course, results in a proportionate increase of field and the generation of a higher EMF. in the armature windings. Any regulation necessary beyond this is performed in the usual way, either by resistance, R_2, in series with the exciter, or by another in its shunt circuit.

As long as the EMF. and current are in phase, and the power factor, therefore, unity, this method serves very well, but these conditions are very infrequently met with owing to lagging currents produced by the asynchronous motors and lightly-loaded transformers that are found in most circuits. As is well known, lagging currents tend to demagnetize the alternator field; therefore the greater the lag the larger the amount of exciting current necessary to compensate for it, and this in addition to the drop in armature volts due to increased load.

A very good method has been devised to get round this trouble, and machines are now built by several large makers that will automatically compensate over all ranges of inductive or non-inductive loads without any hand regulation whatever. The manner of doing this on a three-phase circuit is shown in Fig. 2. A is a diagram of the armature on a three-phase alternator, upon the shaft of which, S, is mounted the exciter armature and commutator, E. This exciter has the same number of field poles as the alternator, so the electrical effects produced in the armature are in strict synchronism with those in the alternator armature. It excites itself, as shown, in shunt direct from the brushes through a regulating resistance. The main current produced passes to the two slip-rings on the right, and so to the revolving alternator field, F.

So far, this is but one of the ordinary methods, and the novelty of the apparatus, and its compensating action, depend upon the three small transformers, T_1, T_2, T_3, and their connection through slip-rings to the exciter armature.

As will be seen, the primaries of the transformers are respectively connected in series with the three main leads from the alternator armature to the 'bus bars; the secondaries are connected as shown, and joined up to the exciter armature at electrically equidistant points by the intervention of the three slip-rings and brushes. Upon the face of it this arrangement may appear rather complicated but its action is really very simple.

The connections to the exciter armature are so made as to cause the auxiliary current supplied from the transformers to set

up magnetic poles in the armature of opposite sign to those of the fields, and, therefore, to strengthen them.

It will be easily seen that on a non-inductive load when the current is in phase with the EMF. an increase of output will naturally result in an increase of alternating current fed into the exciter armature, and, therefore, a strengthening of its field, raising of its volts, and an increase of the current it supplies to the alternator field. On a non-inductive load the magnetic effect of the superimposed current in the armature leads by about a quarter of a period the effect due to the exciter field, but at the same time helps it sufficiently to give the above results on the alternator volts. Now, presuming the load suddenly becomes inductive, the result in the alternator armature is a lag of the current behind the EMF., and consequent demagnetization of the field and reduced volts. The superimposed current in the exciter armature now lags behind its former value, and its magnetizing effect thus approaches nearer to that of the exciter field, consequently helping it more and more as it gets nearer and nearer into phase with it, and thereby increasing the exciter volts, and likewise those of the alternator. On a load containing capacity the manner of action is identically similar, but converse in its results. The armature current will now lead the volts, and the portion that is fed into the exciter armature, as its effect is now leading the field excitation by considerably more than a quarter of a period, will start to oppose it, so lowering the exciter volts, and consequently those of the alternator, which have risen owing to the magnetizing effect of the leading current in the armature on the fields. This method has in all cases that have justified its use given great satisfaction, and there appears to be a large field for it in connection with circuits of which a varying power factor is a feature.

Beyond the above systems of excitation, there is yet another that was in some small use several years ago. It aimed at making an alternator as independent of separate excitation as is a direct-current machine, and this result was attained by winding a series of extra coils on the armature core, bringing the ends to a commutator fixed upon the shaft. This practice has long been discontinued, as its bad points were found to more than equal any benefits that were derived from the absence of separate exciting plant.

With regard to the Elihu Thomson system of compounding, it should be noted that unless a transformer is used instead of the series resistance, the latter should always be placed in the earthed side of the circuit, as otherwise there would be the necessity of extra good insulation on the compounding poles and commutator, and the risk from shock would be serious. Not very many years ago it was customary not to earth one side of the system, under which conditions this machine must have given trouble with the insulation, or at any rate made any dealings with the commutator very dangerous when running.

A few words about the exciting-current switchboard arrangements may not be amiss. Going back again to ancient history, we find many points that were sadly neglected. For instance, the fashion of inserting an ammeter in each alternator field circuit is quite of recent date and a very wise proceeding, as it is of the greatest assistance in working the machines in parallel without the risk of setting up wasteful currents between them. Also resistances have been greatly improved; instead of the old arrangement of a few coarse notches, sometimes hidden, with no attachment to indicate on what portion of the resistance the switch stood, we have rheostats that, while giving a wide range, allow of the most delicate regulation, and if concealed show unmistakably, by means of a mechanically-geared index, the exact proportion of the resistance that is in circuit. There can be no question that the installation of such plant, even though it be comparatively expensive, is justified by the greater ease of working and freedom from break-down risks that go hand in hand with its use.

An earth on the exciter circuit, owing to its usual low voltage, is not a matter of frequent occurrence. It should, however, be guarded against by the use of some simple lamp indicating device, especially in a large station where the cable runs are long and sometimes taken through bad places. Supposing the pressure to be 50 volts, all that is necessary are two lamps of that voltage placed in series across the wires, and a connection taken from between them to earth. Under ordinary conditions the lamps will glow dull red, but if either side goes to earth, one will light up full, and the other go out, the lamp that is out indicating which side of the system the earth is on. If the earth is not dead, there may only be a small difference between the light given out by both lamps, that is to say, they may both be practically only red hot. This, however, can be provided for by the very simple addition of a two-way switch, the arm connected to earth through a low-reading ammeter, and the contacts joined up to the + and — leads respectively. Should the lamps indicate a slight earth, the ammeter, when the switch arm is on the opposite side of that upon which the fault has taken place, will give a reading, from which, by Ohm's law, can be roughly determined the resistance of the fault. It is advisable that a fuse should be in circuit to prevent danger in the event of the switch being used when one of the lamps shows practically a dead earth.

Field switches, it is hardly necessary to state, should be of such a design as to preclude any danger of breaking down the insulation of the magnet winding when cutting the current off it. The rise of potential when the circuit is suddenly broken is enormous, especially in alternators with heavy magnets, and it is necessary that the switch should be so arranged as to insert some form of resistance in circuit before opening, and then to short-circuit the field winding in such a manner as to allow the current in it to die down gently.

In conclusion, the writer would beg to put forward a plea for the better usage of the exciter circuit as a whole; too frequently it is thought nothing of, and provided with a minimum quantity of inefficient apparatus that sooner or later goes wrong often with disastrous effect. The correct way has been pointed out by Ferranti and others in their manufactures, and the thanks of the electrical world are due to these firms, who have made the path of the exciting current as smooth as could be desired.

ELECTRICAL STATION PRACTICE.

ARTICLE XXV.

BY W. H. RADCLIFFE.

In former years there was considerable difficulty experienced in providing suitable insulation within a transformer between the primary and secondary windings. Consequently, the transformation of a high pressure necessitated the use of several transformers in series so that across each of them there would be a comparatively low voltage. The series connection, however, is no longer rendered necessary on account of the adoption of modern methods in design and construction whereby transformations from the highest pressures in commercial use can safely be accomplished in a single tranformer.

In many installations, however, it is frequently found advisable to operate transformers in multiple, so that each of

them may carry approximately that load for which it was designed to give maximum efficiency. In order that transform-

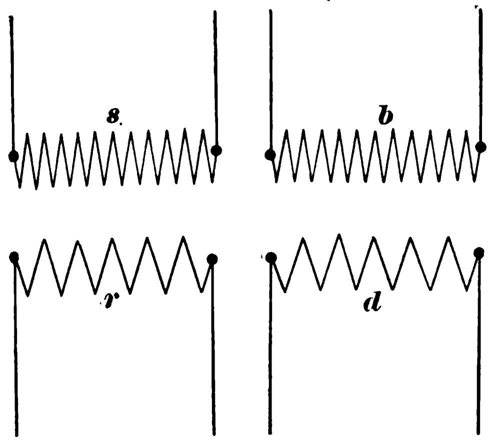

FIG. 21.

ers may give satisfactory results when thus connected, they must be designed for the same pressures and capacities, they must have the same polarity at a given instant, and their percentages of regulation should be the same. One may satisfy himself as to the first of these conditions by examining the name plates fastened to the transformers, whereon are stamped the values of the respective pressures and capacities of each. For information regarding the third condition a special test must be applied.

The test for polarity consists in joining,

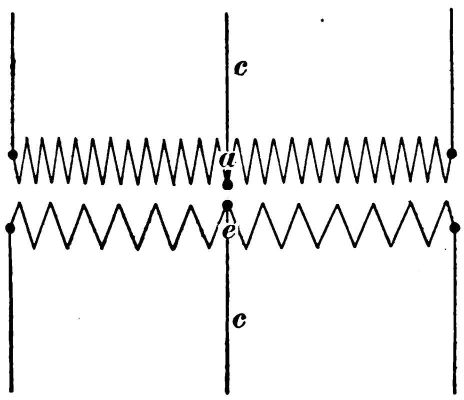

FIG. 22.

by means of a fuse wire, a terminal of the secondary winding of each transformer, and then with the primary windings supplied with normal voltage, connecting temporarily the remaining terminals of the secondary windings. The melting of the fuse wire thus connected indicates that the secondary terminals joined together are of opposite polarities, and that the connections must therefore be reversed, whereas if the fuse wire does not melt it shows that the proper terminals have been joined and that the connections may be made permanent. The object of this test is, obviously, not to determine the exact polarity of each secondary terminal, but merely to indicate which of them are of the same polarity.

Although equal values of regulation is given as one of the conditions to be satisfied, transformers may be operated in parallel when their percentages of regulation are not the same. Ideal operation, however, can only be attained under the former state of affairs. Suppose, for instance, a transformer having a regulation of 2 per cent. be operated in parallel with another of similar size and design but having a regulation of 1 per cent. The secondary pressures of these transformers

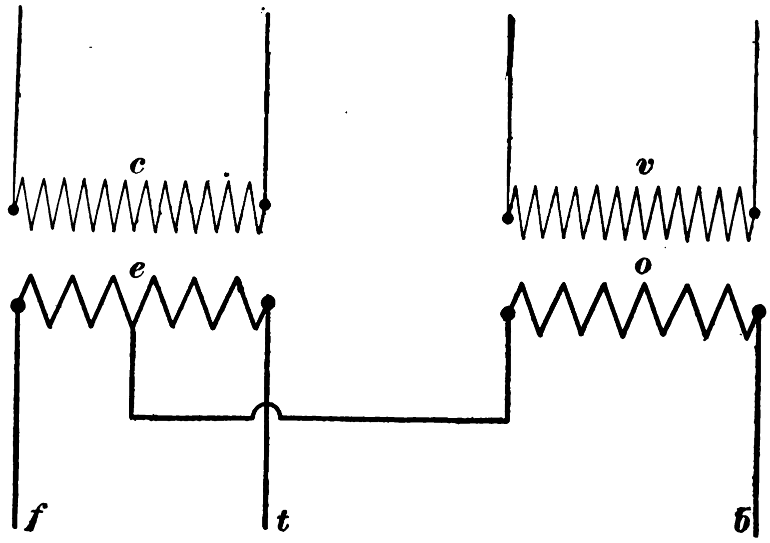

FIG 24.

at no load will of course be the same, but at full load if the secondary electromotive force of the one is 98 volts that of the other will be 99 volts. There will, therefore, be a difference of potential of 1 volt between them which will tend to force a current backward through the secondary winding of the transformer delivering 98 volts. This reversed current,

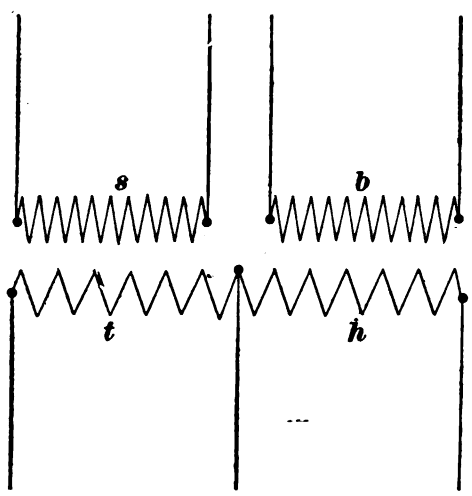

FIG. 23.

although comparatively small in value, lowers the efficiency of the installation by causing a displacement of phase and a decrease in the combined power factor of the transformers.

As previously stated the usual type of transformer has one primary winding and two secondary windings, the latter of which may be joined either in series or in multiple with each other. With the secondary windings in multiple connection, the ratio of primary voltage to secondary voltage in a step-up transformer would be one-half that obtained with the secondaries of the same transformer in series connection but the value of the current would be twice as great. In a step-down transformer the ratio with the secondary windings connected in multiple would be twice that with a series connection, but the value of the current would be but one-half as great.

On a two-phase four-wire alternating current system, transformers are generally connected, as shown in Fig. 21 where *s r* represents a transformer connected in the one phase, and *b d* a second transformer connected in the other phase. In this diagram *s* and *b* represent the respective primary windings on the two transformers, and *r* and *d* the respective secondary windings. This connection is almost entirely employed for lighting and for long two-phase circuits of any kind.

When two-phase installations are operated on the three wire system, two transformers are necessary but these are joined together as shown in Fig. 22, the adjacent ends of both primary and secondary windings being connected together at *a* and *e* respectively, and a common wire, *c*, in both cases led to their respective junctions. Whatever be the primary or the secondary voltage between the common wire, *c*, and either one of the outside wires, this voltage multiplied by 1.414 will equal the pressure in volts between the respective outside wires from either primary or secondary winding.

The transformer connections illustrated in Fig. 23 are used whenever it is desired to convert a two-phase four-wire alternating current system into a two-phase three-wire system, or vice versa. A close

inspection will reveal the fact that the primary arrangement *s b* of the two transformers employed is the same as that shown in Fig. 21, while the secondary arrangement *t h* of the two transformers is the same as that shown in Fig. 22.

A somewhat similar connection to that shown in Fig. 23 is employed when it is desired to convert a two-phase system into a three-phase system, or vice versa. This case is represented diagrammatically in Fig. 24. Two transformers are used, the primary windings *c* and *v* of which are connected to the four wires of the two-phase system as there shown. Suppose there be 1,000 volts across each circuit of the two-wire system, and that it be desired to transform this to a 100-volt three-phase system. The connections must therefore be such that there be 100 volts between *f* and *t*, 100 volts between *t* and *b*, and 100 volts between *f* and *b*. To effect the desired result it is necessary to have the secondary winding *e* in one of the transformers so designed that each half of it will give 150 volts when there is 1,000 volts across its primary winding *c*. Then, if the entire secondary winding *o* of the other transformer be designed to give 86.6 volts with 1,000 volts primary, and it be connected between the two halves of the winding *e* as indicated, there will be supplied to the wires *f t b* a 100-volt three-phase alternating current. This connection of transformers is valuable in that the commendable points of both the two-phase and the three-phase system may be taken advantage of in one system without their respective disadvantages being introduced.

On three-phase alternating-current circuits, transformers may be wired in two ways, the selection of the one method over the other being usually governed by the value of the pressure in use. When high pressures are employed, what is known as the star connection is generally chosen. A diagram showing three transformers thus connected on a three-phase circuit is given in Fig. 25. The primary coils of the three transformers are shown at *v*, *m* and *z*, and their respective secondary coils at *c*, *r* and *e*. Since there are two transformers between any of the line wires *d*, *f* and *b*, the line voltage is not subjected to any one primary winding. Whatever be the pressure between any two of the line wires, the pressure across any one of the primary coils *v*, *m*, or *z*, will be but .577 of that amount, while the pressures induced in the secondary coils will be governed of course by the ratios of the respective transformers. Whatever the value of the secondary pressure induced in each transformer this value will, if multiplied by 1.732, equal the pressure between any two of the secondary distributing mains. The value of the star method for connecting transformers together is now evident, for it is seen that but little more than half the line wire voltage is subjected to each of the primary windings. The star method also possesses advantages over the mesh connection, when, for secondary distribution, a connection is made to the common junction of the secondary windings of the transformers.

As to the primary and secondary currents in this form of connection, that in each primary winding of the transformers is the same as that in the respective line wires between which it is connected. The value of the induced current in each secondary winding of the transformers is greater than that in the corresponding primary winding, in the same proportion as the respective secondary pressure is less than the corresponding pressure in the primary winding. In the secondary distributing mains the current is, of course, the same as in the secondary transformer windings connected thereto.

The mesh connection is more generally employed for three-phase work than is the star connection, unless for reason of the high pressures in use or on account of certain special forms of secondary distribution the star connection is particularly advantageous. In Fig. 26 is given the method of wiring three transformers in mesh connection on a three-phase circuit. To avoid confusion between the mesh and star connections, the similar parts in Fig. 25 and Fig. 26 are lettered the same; by this means there should be no difficulty in understanding the difference between the connections. If now there be a certain voltage between any two of the line wires *d*, *f* and *b*, the voltage across any one of the primary coils *v*, *m* or *z* will be of the same value, while the pressures induced in the secondary coils will, as in the star connection, be governed by the ratios of the respective transformers. Whatever this secondary pressure in each transformer be, this same pressure will exist between any two of the secondary distributing mains.

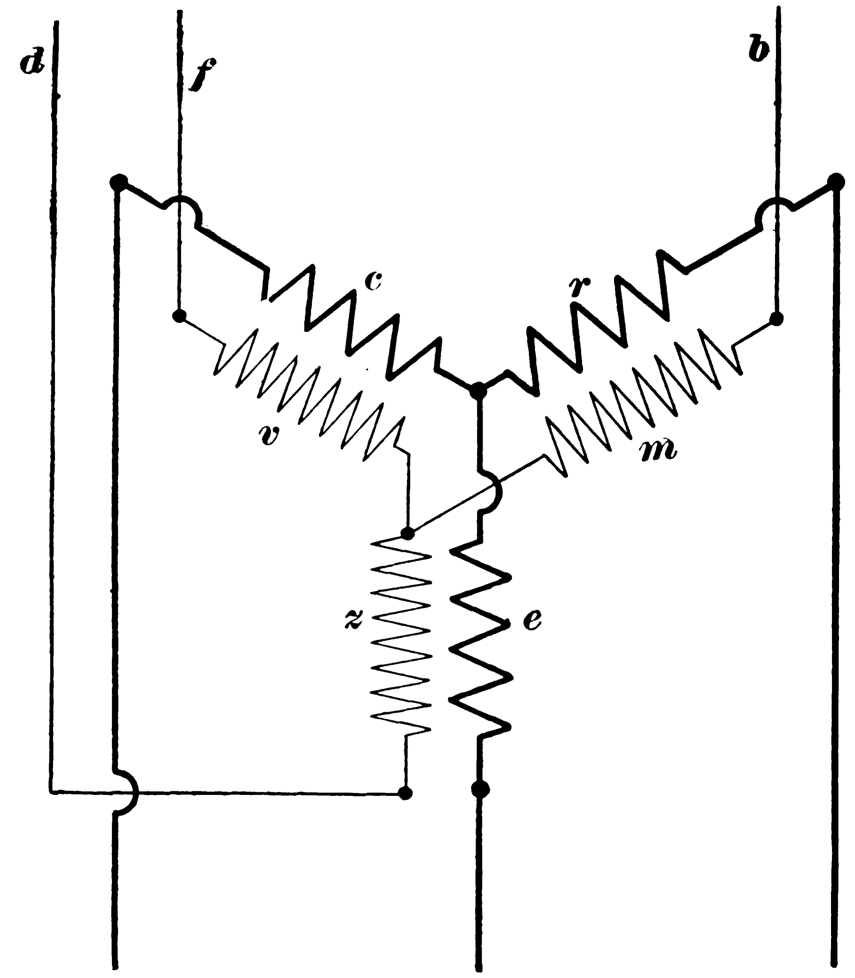

Fig. 25.

Let us now see what happens to the current. Since between any two of the line wires *d*, *f* and *b*, the primary windings of the transformers form a divided circuit, the current in each primary winding will be but .577 of the current in the line wires. The induced current in each secondary winding of the transformers is greater than that in the corresponding primary winding, in the same proportion as the respective secondary pressure is less than the corresponding pressure in the primary winding. In the secondary distributing mains

the current will be 1.732 times that in the secondary transformer winding connected therewith.

The value of the secondary voltage in a three-phase system with respect to the primary voltage may be altered by changing the connections of the transformers to the line wires and distributing wires without changing the respective ratios of the transformers in any way. Thus, if three transformers each with a ratio of 1 to 1, have their primary windings joined in star connection with the three-line wires, and their secondary windings joined in mesh connection with the three distributing wires, the pressures across the secondary circuits will be but .577 of those across the primary circuits. If instead of each transformer having a ratio of 1 to 1, it have a ratio of 10 to 1 with the same connection in use, then the pressure across the secondary circuits will be but one-tenth of .577 or .0577 of those across the primary circuits. The ratio is then 17.3 to 1 instead of 10 to 1, which latter would be the proportion were the transformers joined together with both primaries and secondaries either in star or in mesh connection.

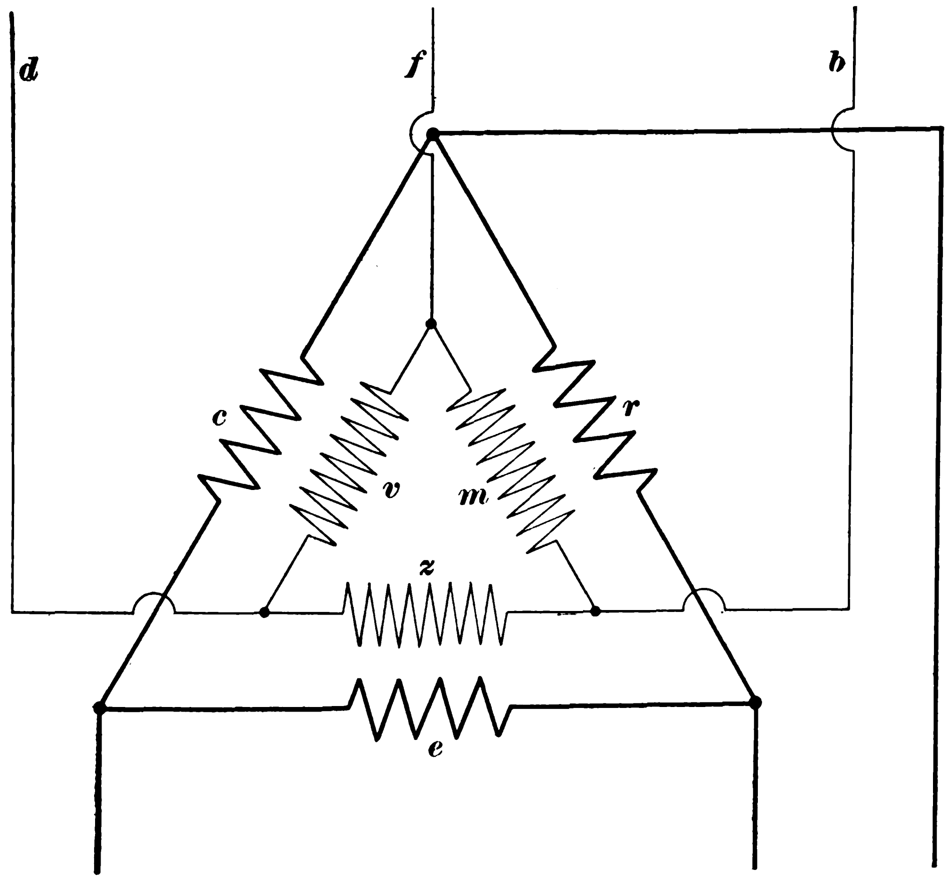

FIG. 26.

Finally, if the transformers each with a ratio of 10 to 1 have their primary windings joined in mesh connection with the three-line wires and their secondary windings joined in star connection with the three distributing wires, the pressures across the secondary circuits will be one-tenth of 1.732 or .1732 of those across the primary circuits. The ratio is then 5.77 to 1 instead of 17.3 to 1, which latter, as has been shown, is the proportion with the mesh and star connections reversed.

COIL WINDINGS FOR ELECTRICAL PURPOSES.*

BY RICHARD VARLEY AND CHARLES R. UNDERHILL.

(*Concluded from page 94.*)

Now let us consider the section and length of insulated wire which is to comprise the winding. First let us get our resistance coefficients.

It has been found by experiment that a commercial soft copper wire .001 inch in diameter has a resistance, at 68 degrees F., of 10.3541 ohms. Now, since for the same length, the resistance of a conductor decreases in direct ratio to the sectional area of the conductor, the resistance will vary with the square of the diameter of the wire. Therefore, denoting the diameter of the wire by $\triangle$, the ohms per foot for any diameter of copper wire will be

$$\frac{.0000103541}{\triangle^2}, \text{ or the ohms per inch}$$

$$\frac{00000086284}{\triangle^2}$$

It is obvious that if we know the length of a given wire that will just fill the bobbin in question we may quickly find the resistance by multiplying the length of the wire by the resistance per unit length. But here we must consider the sectional area of the wire and insulation. For wires of a smaller diameter than No. 20 B. & S. the cotton insulation makes the total diameter .004 inch greater than the diameter of the wire. This is generally referred to as a 4 mil increase.

When the wire is wound into the bobbin, the turns of one layer cross the turns of adjacent layers at an angle, which is dependent upon the diameter of the wire and the diameter of the turn. Therefore, at a certain point on each turn, the corresponding turn of the adjacent layer will be centrally over this turn, but 180 degrees around where the wires cross one another, the wires will imbed slightly.

The gain due to imbedding is approximately 7.3 per cent., but since this gain in space is about equally offset by the spreading of the insulation laterally, due to the vertical tension on the wire during the process of winding. The longitudinal sectional area of the bobbin consumed by each turn of wire is approximately equal to the square of the diameter of the wire and insulation.

The turns, then, are equal to the longitudinal cross-sectional area of the winding divided by the square of the diameter of the wire plus insulation, or $N = \frac{\pi L}{g^2}$

Where

N total number of turns in the winding,
π = thickness of winding,
L = length of winding,
g = diameter of wire plus insulation.

Now the total length of the wire L w in the winding will, of course, be equal to the number of turns multiplied by the average length of all the turns, or

$$L\,w = \frac{\pi\,L\,(D^2 - d^2)}{4\,g^2}$$

Therefore the resistance P of the winding will be

$$P = \frac{.00000086284\,\pi\,L\,(D^2 - d^2)}{4\,g^2\,\triangle^2} = \frac{.0000027107\,L\,(D^2 - d^2)}{4\,g^2\,\triangle^2}$$

To simplify the operation in practice, it is customary to calculate separately the constants for the various sizes of wire, both the resistance and space factors. Since for any given size of insulated wire with given insulation the space and resistance factors may be resolved into the combined space and resistance factor, and in

*Paper read at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

this factor the constant π is incorporated, therefore the resistance P may be found by the simple formula:

$$P = RL\left(\frac{D^2 - d^2}{4}\right)$$

where R equals the combined space and resistance factor.

Space and resistance factors are arranged in the form of tables for reference therefore only the volume of the bobbin need be found in order to ascertain the resistance which may be contained therein with any size of wire, or the size of wire may be determined which will give the desired resistance for any winding volume. In this latter case, however, the true outer diameter of the winding must be recalculated, as the calculated constants seldom coincide with the tabulated constants, therefore the next smaller size of wire is taken and the true outside diameter of the winding calculated by the formula:

$$D = \sqrt{\frac{4P}{RL} + d^2}$$

For windings of square or rectangular cross-section special formulæ are required. However, these formulæ only have to be used in determining the average length of all the turns, as the thickness and length are the same as in a winding or circular cross section.

In order to obtain the theoretical results in practice certain precautions must be taken, for instance, the actual diameter of the insulating sleeve must be taken, and also the exact diameter of the wire and the thickness of the insulation. A change of one ten-thousandth of an inch in the diameter of a No. 35 wire will change its resistance about 6 per cent. for equal lengths of wire, therefore caution must be taken to be sure that it is not stretched during winding, as the ampere turns will be materially reduced.

A slight increase in the insulation will also make a marked change in the amount of wire in a winding.

Also, in calculating the weight of insulated wire the specific gravities of the wire and insulation must be known.

RECTIFIERS.*

BY PROF. CHARLES F. BURGESS.

To correct or redress an alternating nt so that it may serve certain purposes, such as charging storage batteries, is the function of the so-called alternating current rectifier. The perfection of these devices has occupied the attention of various engineers and scientists during recent years, and the progress made has been such as to bring the subject to a state of practical importance to the central station operators.

A rectified current, properly speaking, is that derived from an alternating source of pressure in which both halves of the complete alternating cycle are utilized. The ideal rectified curve would be produced by inverting the lower half of the alternating curve, the resultant being a curve of unidirectional, pulsating nature. The term, however, is sometimes improperly applied to the interrupted pulsating current produced by suppressing one-half of each cycle, but the newest and most improved rectifiers utilize the complete cycle.

Rectifiers may be divided into three general types, mechanical, vapor and electrolytic.

Omitting the rotary converter, which is essentially a direct current dynamo driven by an alternating current motor, and is not a rectifier in the commonly accepted meaning of the term, the mechanical rectifiers include the synchronously-driven, rotating reversing switch, and the vibrating reverser in which the contact maker is maintained in synchronous vibration by energy derived from the alternating circuit. The destructive sparking which it is almost impossible to suppress, and the tendency of the storage battery or other translating device to discharge when its pressure is greater that the instantaneous values of the pulsating rectified pressure, have prevented these devices from being extensively adopted in spite of their low cost as compared with the rotary converter. A vibrating rectifier was advertised not long ago by an English manufacturer, but the inertia of the moving part, together with the objections referred to, undoubtedly will prevent this from being of value except for the smallest capacities.

Certain materials have been discovered which have a low resistance when the current flows in one direction and an extremely high value when the direction of the current flow is reversed. Conductors possessing this property have been designated "asymmetric" conductors. It is this property that the vapor and electrolytic types of rectifiers utilize.

The electric arc playing between carbon terminals has for a long time been known to possess the property of asymmetry, but not in sufficient degree to warrant its practical application. In the discovery of the so-called "Edison effect" some twenty years ago, it was shown that a rectified current could be obtained from an alternating current by means of an extra electrode inserted in an incandescent lamp. Various other vapors have been found to possess this property, the most pronounced results being those recently pointed out by Mr. Cooper Hewitt in his remarkable work on the conductivity of mercury vapor. In this Mr. Cooper Hewitt has demonstrated the possibility of utilizing the mercury vapor conductor in the construction of a rectifier or converter having an efficiency of 98 per cent. and above. His apparatus is remarkable in its large amount of energy converted per unit of weight and volume and also for the high efficiency, which can scarcely be approached by any other form of electrical converting apparatus. At present these converters are apparently in the development and experimental stage, but hold out great promise as a successful rectifier for various classes of service.

Though for the past 20 years it has occupied a prominent place in scientific and technical literature, the third class or the electrolytic rectifier has only recently been placed upon the market in this country. This form of rectifier is sometimes designated as an electrolytic valve, and, as such, has an analogy in the hydraulic check-valve which automatically allows water to flow freely through a pipe in one direction, but prevents its passage in the opposite direction. The discovery upon which the electrolytic rectifier of to-day is based was made a half century ago when it was found that aluminum in certain solutions possesses the property of opposing in a high degree the passage of the current from it to an electrolyte, and of freely allowing its passage in the opposite direction.

It will be evident that the efficiency of such an electric valve must depend upon the rapidity with which it acts, upon the completeness with which it stops the flow of current in the one direction, and upon the high conductivity which it allows for the passage in the reverse direction. With the commercial frequencies now employed of from 25 to over 100 per second it is evident that this valve must act with great rapidity. Without going into details as to this factor, or the method of determining it, I may state that an investigation of this question in our laboratory has shown that an aluminum plate immersed in a sodium nitrate electrolyte required about 1-1100 second for "closing the electrical valve" at each reversal of pressure.

There are many solutions which in contact with aluminum allow this electrolytic valve action to become manifest. Some solutions are naturally more efficient than are others and it is to the study

* Paper read at the twelfth annual convention of the Northwestern Electrical Association held at Milwaukee, Wis., Jan. 20-22, 1904.

of the relative behavior of different materials that most attention has been given during the past few years.

Although extravagant claims have been made from time to time as regards efficiency, durability and other factors, these claims have almost invariably failed of realization under practical conditions, and it is only recently that improvements have brought the working efficiency of the apparatus up to a point where it can be used commercially. It is not yet all that may be desired, but for certain classes of work, such as charging small storage battery equipments, it offers decided advantages.

Among these advantages which have made the electrolytic rectifier an attractive problem for study and investigation are the following: In possessing no moving parts it is a close approximation to the static alternating current transformer, requiring little or no attention during operation. The materials of which it is constructed are cheap and the total cost should be lower than that of the ordinary transformer for equivalent outputs. The electrolytic rectifier has a high power factor. It requires little or no abnormal rush of starting current. It has in its present condition an efficiency in the neighborhood of 50 per cent., and, what makes it especially desirable for a certain class of work is that it can be made in small sizes at such a cost as will permit its general use where small storage batteries are to be charged from alternating current circuits. Where direct current circuits are available and two or three more storage cells are to be charged from them, the common, though wasteful method, is to connect the batteries in series with a suitable resistance, with the electrolytic rectifier, advantage may be made of pressure transformation rather than rheostatic control, thus effecting a large saving in the power consumption.

The electrolytic rectifier has certain limitations, one of which is that for a single cell a pressure much greater than 50 or 60 volts cannot be maintained at a high efficiency; and where higher pressures are necessary two or more cells must be operated in series.

Tests which have been made in our laboratories on the efficiency of a large number of electrolytic rectifiers of various types have shown that the best of them operate, under practical working conditions, at an efficiency between 50 and 60 per cent. Tests on various sizes of a certain type of rectifier have shown that this efficiency is practically constant, regardless of size, and in this respect the rectifier differs materially from most types of electrical apparatus, where the efficiency usually increases in value as the size of the outfit is increased.

(*To be continued.*)

American Institute of Electrical Engineers.

The 184th meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West 55th street, New York, Friday, February 26, at 8:15 P.M. The following papers will be presented and discussed: "European Practice in the Construction and Operation of High-Tension Transmission Lines and Insulators," by Guido Semenza, chief electrical engineer of the Italian Edison Company of Milan, Italy; "Conductivity of the Atmosphere at High Voltages," by Harris J. Ryan, professor of electrical engineering, Sibley College, Cornell University, Ithaca, N. Y.

Society of Chemical Industry.

The New York Section of the Chemists' Club met last Friday evening at 108 West 55th street. The following papers were read: "A Method of Determining the Percentages of Aldehydes in Certain Essential Oils," by Samuel S. Sadtler; "Graphitic Acid or Oxide," by Frederic S. Hyde; "Radium and Radio-active Substances" (demonstration and exhibits), by Hugo Lieber; "The Iodine Absorption of Spirits of Turpentine," by R. A. Worstall.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEBRUARY 16, 1904.

Electric Railways and Appliances.

752,037. Electric Train-Service. Melvin D. Compton, New York City. Filed Dec. 2, 1901. Renewed Sept. 12, 1903.

752,121. Trolley-Finder. Elisha S. Stitt, Newton, Mass. Filed Oct. 17, 1902.

752,127. Railway Switching and Signaling Apparatus. John D. Taylor, Buffalo, N. Y., assignor to the Taylor Signal Company, same place. Filed Jan. 12, 1901.

752,139. Trolley-Catcher. William C. Young and Johnston McMahon, Buffalo, N. Y. Filed June 1, 1903.

752,374. Automatic Check Device for Trolley-Cords. Seth J. Buckland, Springfield, Mass. Filed April 22, 1903.

752,437. Overhead-Trolley Guide. Charles W. Burkhead, Madisonville, O. Filed Aug. 16, 1902. Renewed Oct. 22, 1903.

752,501. Trolley-Hanger. Montraville M. Wood, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 8, 1903.

Electrical Machinery and Apparatus.

752,048. Electric Meter. Thomas Duncan, Lafayette, Ind. Filed Oct. 23, 1903.

752,097. Automatic Starter for Electric Motors. William C. O'Brien, Baltimore, Md. Filed May 4, 1903.

752,168. Dynamo-Electric Machine. Hans Holzwarth, Hamilton, O., assignor to the Hooven, Owens, Rentschler Company, same place. Filed Nov. 21, 1903.

752,192. Electric Switch. Charles C Badeau, Swissvale, Pa. Filed Aug. 12, 1903.

752,236. Electric Generator. Hans Liebreich, Boston, Mass., assignor to the International Electric Company. Filed June 29, 1903.

752,345. Electromagnet. James C. Keller and Otto F. Kadow, Cleveland, O. Filed May 23, 1903.

752,376. Electric-Brush Holder. De Witt C. Cookingham, Cleveland, O., assignor of one-half to John H. Hertner, same place. Filed Oct. 15, 1903.

752,384. Electrical Igniter for Explosive-Engines. Willard E. Dow, Braintree, Mass. Filed July 2, 1903.

752,391. Electric Motor. Christian Fleischmann, Bloomfield, N. J. Filed June 24, 1903.

752,405. Transformer. Charles B. McCurdy, Warren, O., assignor, by direct and mesne assignments, to the Peerless Electric Company, same place, and Frederick C. Sutter and Robert V. Bingay, Pittsburg, Pa. Filed April 24, 1903.

752,528. Protective Means for Electric Boosters. Maxwell W. Day, Schenectady, N. Y., assignor to the General Electric Company. Filed July 6, 1903.

752,531. Electric Switch. Warren K. Dodge, Manhattan, Kan. Filed Oct. 23, 1903.

Telephones and Telephone Apparatus.

752,184. Hanger for Telephone Transmitters. Micheal Setter, Chicago, Ill., assignor to the American Electric Telephone Company. Filed May 8, 1902.

752,251. Automatic Telephone System. John K. Norstrom and John J. Brownrigg, Chicago, Ill., assignors, by direct and mesne assignments, to the Globe Automatic Telephone Company. Filed June 28, 1901.

752,613. Relay. Albert Carliss, Chicago, Ill., assignor to the American Electric Telephone Company. Filed May 25, 1901. Renewed Dec. 23, 1903.

Miscellaneous.

(Issued Feb. 9, 1904.)

751,739. Insulator. Peter S. Lindell, Edinburg, Pa. Filed March 31, 1903.

751,743. Insulator. Joseph M. Mahoney, Boston, Mass. Filed Dec. 1, 1902.

751,760. Electric Signaling Apparatus. John E. Stannard, Springfield, Mass. Filed Feb. 2, 1903.

751,664. Electric Insulator. Thomas T. Lyman, Montclair, N. J., assignor to the H. W. Johns-Manville Company, New York City. Filed April 4, 1902.

751,772. Storage Battery Plate. Charles B. Askew, Chicago, Ill. Filed May 20, 1903.

751,780. Electric Signal. Harold E. Bradley, Warwick, R. I. Filed Oct. 3, 1903.

751,781. Electric Alarm Clock. Harry A. Chase, East Orange, N. J. Filed March 6, 1900.

751,788. Electrical Signal Apparatus. John M. Golding, Washington, D. C. Filed July 15, 1903.

751,803. Wireless Electric Apparatus Acting on Type-Writers. Giuseppe Musso, S. Angelo del Lombardi, Italy. Filed Sept. 23, 1902.

751,818. Electrically Produced Sound Intensifier. Gustaf T. Swenson, San Pedro, Cal. Filed Dec. 17, 1902.

751,831. Insulator Pin. James H. Bullard, Springfield, Mass. Filed Aug. 8, 1903.

751,839. Electric Hair Brush. Henry C. Doersch, Nyack, N. Y., assignor of one-half to William S. Pickard, Brooklyn, N. Y. Filed June 1, 1903.

751,857. System of Electrical Propulsion. Erich Krause, Hoboken, N. J., assignor of one-fifth to Hans Kurten and Rosa Kurten, same place. Filed Oct. 22, 1903.

(Issued Feb. 16, 1904.)

752,150. Electric Selective System. Julien A. Gehrung, St. Louis, Mo. Filed Feb. 8, 1902.

752,259. Telegraph-Pole. John H. Purdy, New London, O. Filed June 15, 1903.

752,349. Battery Stem-Guide. William H. Martin Nevada City, and Alexander McComble, Grass Valley, Cal. Filed July 22, 1903.

752,357. Process of Electrically Heating Articles. Edgar F. Price, Niagara Falls, N. Y., assignor to the Union Carbide Company. Filed Nov. 5, 1902.

752,358. Process of Heating Articles by Electricity. Edgar F. Price, Niagar Falls, N. Y., assignor to the Union Carbide Company. Filed Nov. 5, 1902.

752,408. Electrical Apparatus for Producing Sound-Signals. Charles H. O'Brien, Augusta, Me. Filed Nov. 1, 1902.

752,419. High-Tension Therapeutic Electrode. Manuel R. Rodrigues, Brooklyn, N. Y. Filed June 3, 1901. Renewed July 9, 1903.

752,493. Molding-Case for Use in Electrotyping and Process of Manufacturing Same. William H. Welsh, Collingswood, N. J. Filed Oct. 13, 1903.

752,533. Wireless Signaling. Daniel Drawbaugh, Eberlys Mills, Pa. Filed March 1, 1902. Renewed July 15, 1903.

752,534. Method of Transmitting Intelligence Through the Natural Mediums. Daniel Drawbaugh, Eberlys Mills, Pa. Original application filed March 1, 1902. Renewed July 25, 1903. Divided and this application filed June 28, 1902. Renewed July 15, 1903.

752,544. Electrical Device for Shocking Horses. James A. Giles, Elberton, Ga. Filed Sept. 24, 1902.

752,589. Electromagnetic Reversing Device. John Riddell, Schenectady, N. Y., assignor to the General Electric Company. Filed May 28, 1900.

752,590. Magnetic Clutch Application. John Riddell, Schenectady, N. Y., assignor to the General Electric Company. Filed July 27, 1901.

THE TELEPHONE WORLD.

Americans to Install Telephone System in Mexico.

An extensive up-to-date telephone system is to be installed in Mexico City. S. G. McMeen, a Chicago expert, is now in that part of the world for the purpose of making a study of the field and mapping the results as a final preliminary to digging trenches and laying the conduit cables. The cables in the underground section of the city will be laid in terra cotta pipes, 18 inches in length. These pipes will be laid in trenches at a depth of about 3 feet from the street. The cables will weigh about 6 pounds per running foot. Percival F. Burgess is the general manager of the company which is to build and operate the new system. A large new central station will be built and a modern switchboard installed. The visual signal system will be employed. All the necessary equipment will be purchased in the United States.

John Woessner, an American, has secured a concession from the Mexican Government to construct an extended long-distance telephone system in Northern Mexico. A system will be installed in Monterey in the first instance. The line will then be extended to Tampico, passing through the towns of Linares, Victoria and other places. The system is also to be extended to the city of San Luis Potosi and thence to Mexico City. Local exchanges will be installed in nearly all of these cities.

By March 15 Little Rock, Ark., will have direct telephone connection with St. Louis, Mo., as that date will mark the completion of a telephone line along the right of way of the main line of the Iron Mountain from St. Louis as far south as Little Rock. The line is being built by the American Telegraph & Telephone Company. The completion of this Little Rock-St. Louis line will also give Memphis a new line to St. Louis via Little Rock. This telephone company put in its own poles as far south as Walnut Ridge. From there south to Little Rock its wires are being strung on the poles of the Southwestern Telegraph & Telephone Company, which has long distance lines in all directions out of Little Rock. The present toll rate to St. Louis from Little Rock via Memphis is $2 for a 3-minute talk from 6 A.M. to 6 P.M., and half that rate for talks at night, or between 6 o'clock in the evening and the same hour in the morning. It is not known whether this rate will be cut.

The entire plant of the Lebanon, Telephone Company of Lebanon, Ind., is being rebuilt. This includes the installation of six sections of new flashlight switchboard and the stringing of 15,000 feet of aerial cable. The work is being pushed very rapidly under the supervision of Floyd Jones, general manager for the company, who says that it will be completed by March 1.

At a meeting of the executive council of the Michigan Independent Telephone Association at Grand Rapids, February 4, it was decided to admit manufacturers and dealers of telephone equipments as associate members of the association on the payment of $5 dues per year.

The Moffit Telephone Company wants a new franchise for the city of Billings, Mont.

New Company Opens Exchange.

For a long time the residents of the lower portion of Luzerne County, Pa., and connecting territory, have been caused much inconvenience on account of not being able to enjoy service, but the opening of the Shickshinny Exchange of the Lower Luzerne Telephone Company lately met with the hearty approval of Shickshinny business men who now, that they have been furnished with efficient telephone service at reasonable rates, appreciate the fact that they would still be handicapped by inadequate service and high tariff had not the new company started operations in their territory. The Lower Luzerne Company has spared no expense in the matter of construction, and the material used and apparatus installed is the very best obtainable, thus insuring good service, and it is the intention of the company to maintain the highest possible degree of efficiency.

A large number of subscribers have been connected with the exchange and new connections are being made daily. The company has also constructed a toll line connecting the Shickshinny Exchange with the lines of the Consolidated Telephone Companies of Pennsylvania at Nanticoke, and with the lines of the United Telephone & Telegraph Company at Berwick, and is therefore prepared to furnish long distance service. The rates for such service are very low as this new line makes a short route and the public will be greatly benefited thereby.

The Independent telephone companies have made remarkable progress in that territory and the opening of this new toll line and the Shickshinny Exchange is but one of the many developments that will soon be brought about. The line has been built with local capital, and the officers are W. G. Harding, president, and Charles West, secretary and treasurer.

At the annual convention of the Independent telephone companies of Wisconsin, recently held in Milwaukee, the old officers were elected as follows; President, Richard Valentine, of Janesville; vice-president, H. G. Slater, of Waupaca; secretary and treasurer, H. C. Winter, of Madison. Nine new companies were received into membership, as follows: The Mazomanie Telephone Company, the Kingston Telephone Company, the Columbia County Telephone Company, the Independent Consolidated Telephone Company of Weyauwega, the Cambridge Telephone Company, the F. Bissell Telephone Company of Toledo, O., the Fulmer Telephone Company of Florence, and the Signalphone Telephone Company of Milwaukee.

The Evansville, Wis., Telephone Exchange Company, by its president, A. S. Baker, and secretary, R. M. Richmond, recently filed an amendment increasing its capital from $2,500 to $20,000.

The Footville, Wis., Telephone Company, by S. W. Lacy, president, and W. O. Howell, secretary, has filed an amendment increasing its capital stock from $4,000 to $10,000.

The net output of the American Telephone & Telegraph Company decreased 32,761 instruments during the month ended January 20 last.

The Cumberland Telephone & Telegraph Company has leased the Globe Telephone Exchange at Cadiz, Ky., from A. P. White. It will overhaul the entire system and in a short while Cadiz will have one of the best telephone systems of any little town in the State. The lease is for an indefinite time. Mr. Will Collins of Hopkinsville, will have charge of the business in Cadiz.

George Carker, William Hawley and William Burgdorf have formed a company for the purpose of constructing a telephone line from Westbury to Wolcott, with a loop to Red Creek, N. Y. They have secured permission to erect the line along the plank road and into the village of Wolcott.

By a recent unanimous vote the Butler County, O., commissioners granted the Hamilton Home Telephone Company a franchise to erect and maintain poles and wires for telephone and telegraph purposes along the roads and highways of that county under the usual conditions.

The Ellsworth Mutual Telephone Association of Ellsworth, Ia., has been formed with a capital of $10,000 by John H. Sparhoe, Holden Thompson, O. M. Lyders, Barney Peterson, John O. Anderson, Dan Knudson, F. R. Dalbey, John P. Holt and M. H. Brinton.

The Dayton, O., Home Telephone Company, by the necessary procedure recently brought in the office of the Secretary of State, reduced its capital stock from $750,000, to $600,000, and immediately increased its capital to $1,000,000, the increase being 5 per cent. preferred stock.

The reconstruction of the telephone system in Manila is projected. The Philippines Commission is now considering a proposed act which will direct the Manila Telephone Company to install a new switchboard and other modern appliances in the central office and in other portions of the system.

The People's Rural Telephone Company, with registered office at Wenonah, N. J., has a capital stock of $50,000. Warren Atkinson, George Horner, Asa Moore and others are the incorporators.

R. S. Underwood, traffic agent of the Cumberland Telephone Company, will resign his position March 1 to accept the position of superintendent of the Central Union Telephone Company at South Bend, Ind.

The Barron County, Wis., Telephone Company, by De Witt Post, president, and T. W. Borum, secretary, lately filed an amendment increasing the capital stock from $2,500 to $20,000.

The Wright County Telephone Company of Waverly, Minn., has been incorporated with a capital of $50,000.

Telephone Incorporations.

The Egg Harbor Telephone Company, Egg Harbor City, N. J. Capital stock, $10,000.

The City Telephone Company, Turtle Lake, Wis. Capital stock, $2,000. Incorporators: Frank E. Fisk, John Hogan and W. W. Fisk

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bay City, Mich.—The citizens will vote April 4 on the issue of $50,000 of bonds to put the municipal electric light and power plant in condition to furnish electricity to private consumers.

Browning, Mo.—This village proposes to have electric lights.

Brownsville, Ore.—This town is soon to have electric lights.

Burlington, Wis.—The council has appointed a committee of citizens to investigate the feasibility of building a municipal electric light plant.

Caldwell, Ida.—This city is figuring on putting in an electric light plant. Mayor Stennenberg will report on cost at the next council meeting.

Calhoun, Ga.—T. W. Harbin of this city will require a complete equipment, save boiler, for an electric light plant of a capacity of 12 arc lights and 500 incandescents.

Culiacan, Mex.—The limit of time for the reception of bids for the electric lighting of this city has been extended to March 31.

Danbury, Ia.—The citizens are contemplating the installation of an electric light plant.

Delphi, N. Y.—The citizens are discussing the question of bonding the village for $20,000 for a municipal electric lighting plant,

Des Moines, Ia.—Major R. B. Turner, quartermaster, states that a $40,000 electric lighting plant is to be built at Fort Des Moines. Plans are are now being prepared for same at Washington.

Glasgow, Mont.—The citizens will soon vote on the proposition to establish city waterworks and an electric light plant.

Glenwood, Tex.—A company is reported as projected here for securing electric lights for this place and Polytechnic Hill.

Hartford, Conn.—The Jacob Manufacturing Company, of which L. W. Ripley is treasurer, contemplates the general development of water power, also a hydro-electric light plant and two dams at Glastonbury.

Homer, La.—A movement is in progress to secure electric lighting for this place.

Jeffersonville, Ind.—J. Tompkins, electrician and contractor, will at the next meeting of the Scottsburg town board submit a proposal to erect an electric light plant and furnish the town with illumination.

Kemps Creek, Ala.—Frank F. Taylor, of this place, will want prices on an electric light plant in about 60 days.

Lenox, Ia.—The citizens will vote on granting a 25-year franchise for electric lights at the spring election.

Libby, Mont.—A private electric light plant is to be established if sufficient patronage is guaranteed. A. B. Johnston is interested.

Ligonier, Ind.—The electric light plant here owned by J. W. Draper was lately damaged by fire to the amount of $2,500.

Manistique, Mich.—It is stated that Benjamin Gero has purchased Fred Miller's stock in the Manistique Electric Light Company, paying $10,000 for same. The company contemplates expending $7,000 in increasing the capacity of the plant and otherwise improving it.

Marysville, O.—The city council at its regular meeting introduced a resolution authorizing an investigation to be made of the expense of constructing and operating a municipal electric light plant.

Ness City, Kan.—An electric light company has been organized here and will begin at once installing machinery.

Roberts, Ill.—This city will be lighted with electricity before long.

Sault Ste Marie, Mich.—Alexander Dow and other Detroit capitalists are stated to have bought the Edison Sault Electric Conpany's plant here with the intention of making extensive improvements.

Shippensburg, Pa.—Arrangements are being perfected for the merging of the Shippensburg Gas Company and the Electric Light & Power Company into the Shippensburg Heat, Light & Power Company. The electric power will be furnished by water about two miles distant from the borough.

Springville, Utah.—A special election to bond this city for $14,000 to pay off the indebtedness of the city on the electric light plant resulted in favor.

South Norridgewock, Me.—The citizens are contemplating installing an electric light plant.

South Stillwater, Minn.—The question of voting on the issuance of bonds for an electric lighting plant here will be voted on March 8, and the issue will not be more than $15,000, nor less than $10,000.

Stottville, N. Y.—This town is to have electric lights in the near future.

Stronghurst, Ill.—Messrs. White and Kyler have received an electric light franchise from the village of Kirkwood to cover a period of 20 years, but the exclusive right was omitted.

Sutton, Neb.—The city council has granted a franchise to the Sutton Electric & Power Company to light the city. The franchise runs 15 years.

Walnut, Ia.—It is reported that this city is calling for bids for the erection of an electric light plant. Address A. R. Longnecker, clerk. The estimated cost is about $14,000.

West End, Ala.—The city council and the citizens are contemplating the institution of the municipal ownership, and their first move in this direction will be the erection of an electric light plant.

Willspoint, Tex.—The Willspoint Electric Light Company has been incorporated with $10,000 capital to construct and operate an electric light plant. O. L. Johnson, Charles E. Brown and W. B. Ridges are interested.

STREET RAILWAYS.

Americus, Ga.—A street railway building concern is making negotiations to the end of constructing an electric railway here, and while definite conclusions have not as yet been reached the hope is expressed that Americus will secure this enterprise.

Houston, Tex.—The power plant of the United Railway Company was lately destroyed by fire.

Oshkosh, Wis.—J. K. Tillotson, a promoter of railroads, is here trying to interest the citizens in an electric line for this city.

Philadelphia, Pa.—The West Branch Electric Railway Company has been incorporated with a capital of $18,000.

Pittsburg, Pa.—The Northern Electric Street Railway Company, lately incorporated with a capital of $15,000, has the following directors: F. E. Scott, H. D. Jones and others.

Quincy, Mich.—The common council has granted a franchise to the Toledo & Michigan Railway Company, which proposes to build an electric railway line from Adrian to Coldwater.

Richmond, Va.—It is stated that Frank Gould, owner of the electric street car system here, contemplates its ultimate extension to Washington by the way of Ashland and Fredericksburg.

Saco, Me.—There is a rumor to the effect that a new electric road between here and Bonny Eagle is one of the possibilities of the coming season. James O. Bradbury of this place is interested.

Springview, Neb.—A new company is being formed here to build an electric line from here to Newport, with a capital stock of $300,000. City Engineer Rosewater of Omaha is to be employed.

Stonington, Conn.—A certificate of organization of the Westerly Railway & Lighting Company of this place has been filed in the office of the Secretary of State. The company is organized to construct and operate railroads, street railroads, electric light plants, power plants, gas works and ferries. The authorized capital stock is $400,000.

POWER PLANTS.

Covington, Ga.—There is a company being organized here to develop the water power on Alcovy River, 10 miles south of here. This fall is over 100 feet and a good volume of water that will generate an immense horse power. This water power and a large body of land adjoining belongs to three local capitalists, N. S. Turner, C. H. White and W. C. Clark.

Marble Falls, Tex.—It is reported that the Colorado River Falls at this place are to be utilized for the development of electricity.

Walla Walla, Wash.—The Northwestern Gas & Electric Company is taking steps for constructing a huge power plant on the Walla Walla River near this city in Umatilla County, Oregon. The company will furnish electric power for heating and manufacturing purposes in Walla Walla, Pendleton, Athena and other towns.

BIDS WANTED.

Washington, D. C.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until March 1, for furnishing the navy yards at Norfolk, Va., Charleston, S. C., and Port Royal, S. C., with a quantity of electric blowers, electric fans, electric traveling cranes, etc. Blank forms of proposal may be obtained upon application to the navy pay offices in the above-named cities.—William M. Meredith, director of the Bureau of Engraving and Printing in this city, is inviting sealed proposals until April 12 for furnishing the Bureau with a large quantity of electrical supplies, a list of which will be furnished upon application.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12¼@12½c.; Lake 12⅜@12⅝c.; casting, 12¼@12⅜c.

The Michigan Electric Company of Detroit has been placed in the hands of a receiver.

The New Jersey & Pennsylvania Telephone Company is to be sold under foreclosure to satisfy a mortgage for $125,000.

The Chicage Union Traction franchise extension is to be side-tracked until the service has been improved and public confidence regained.

The Memphis Telephone Company has executed a $1,000,000 mortgage to secure the issuance of bonds to pay off indebtedness and to make improvements.

The Newark (N. J.) Electrical & Construction Company has been incorporated under the laws of the State of New Jersey with a capital stock of $125,000.

The Indiana Union Traction Company, the management of which is directed by Philadelphia interests, will hold its first annual meeting, March 1, at Anderson, Ind.

The Chicago Railroad Terminal Elevator Company of New York, which ten years ago issued bonds amounting to $2,500,000, has been placed in charge of a receiver.

Control of the Knoxville (Tenn.) Traction Company and the Knoxville Electric Light & Power Company has been bought from the Railways & Light Company of America by a New York syndicate.

A special meeting of the stockholders of the Nassau Light and Power Company (Brooklyn, N. Y.) has been called for March 4, to act on, among other things, an increase in the capital stock from $500,000 to $1,500,000.

American Telephone & Telegraph Company (Bell) shares have been under attack the past week by Boston and New York "bears." The bond issue of $20,000,000, reported in last week's ELECTRICITY, is not meeting with favor by investors.

Robert E. Wright, C. M. Bates and George W. Norris, receivers of the Lehigh Valley Traction Company, have filed an answer to the allegation of the Easton (Pa.) Consolidated Electric Company, denying that in their management of the Lehigh Valley Traction Company they have in any way violated the lease of the Easton Company.

At the annual meeting of the Philadelphia Bell Telephone Company, the old board of directors was re-elected. The president's report shows net earnings for the year of $930,240. Dividends paid amounted to $852,367. Balance to profit and loss was $77,873. The number of stations in Philadelphia at the end of the year were 45,544.

The annual report of the Electric Company of America is expected to show net earnings for 1903 of $398,000, as against $349,000 the previous year, an increase of $49,000. It is said that the balance credited to the surplus of profit and loss account, after the payment of dividends, will exceed $600,000, against $453,000 the previous year.

The $5,000,000 refunding hundred-year 4 per cent. bonds of the Brooklyn Rapid Transit Company, application to list which was made last week to the Stock Exchange, and announced in ELECTRICITY, are not a new issue as was supposed by some at the time. They are the first bonds issued under the mortgage and were sold to Flower & Co. in May, 1902. They are not the bonds said to have had been hypothecated by the company recently for a time loan to carry on improvements. This loan amounts to less than $1,000,000.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Feb. 19
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	141¾
Metropolitan Street Railway	116⅝
Metropolitan Securities	86
Ninth Avenue	200
Third Avenue	119½
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	235
Brooklyn Rapid Transit	43½
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	64
Philadelphia Traction	97¼
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	140
West End Street, com	90½
do. do. do. pref	109
Chicago.	
City Railway	165
North Chicago	87
Union Traction, com	4½
do. do. pref	29½

ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.

New York City.	
Electric Boat, com	21
do. do. pref	47
Electric Lead Reduction	⅞
Electric Vehicle, com	9
do. do. pref	13
Westinghouse, com	159
do. pref	194
General Electric	163
Boston.	
Edison Electric Illuminating	235
General Electric	163
Massachusetts Electric Companies, com	21
do. do. do. pref	78
Westinghouse Electric & Mfg., com	79
do. do. do. pref	90
Chicago.	
Chicago Edison	152½
National Carbon, com	25
do. do. pref	94
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	55
do. do. do. pref	..

TELEPHONE AND TELEGRAPH STOCKS.

Boston.	
American Telephone & Telegraph Company	121
Western Telephone Company	11
New England Telephone Company	120
New York.	
American Telegraph & Cable Company	84¾
Commercial Cable Company	192
Mexican Telephone Company	2
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	87
Miscellaneous.	
Chicago Telephone Company	120
Tel., Tel. & Cable Company of America	78

INDUSTRIAL AND MISCELLANEOUS STOCKS.

Otis Elevator Company	30
Consolidated Car Heating	64
Standard Underground Cable	200

ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

A So-Called Wireless Trolley System.

A recent article in a well-known New York daily paper, describing at considerable length a so-called wireless trolley system in operation in the south of Jersey, has a tendency to mislead the general public. The article says:

"A revolution in railway transportation will be achieved, it is believed, by the invention of a wireless trolley. In the new system the overhead or underground wires are done away with, as well as the third rail. The danger element is completely eliminated, it has been demonstrated, in doing away with these wires. The cost of installation and maintenance is enormously reduced. All that may be done with the ordinary trolley system as regards high speed and economy of transportation, it has apparently been shown, may be done better by wireless trolley."

Further on the writer of the article describes the system as follows:

"There is no slot with its underground wires, no third rail. Nor are the cars supplied with storage batteries. At intervals of 16 feet or more extending midway between the tracks is a series of little metal buttons, and that is all. The buttons rise only an inch above the surface of the street or road. One must look closely to see them.

"The system itself, however, is extremely simple. These inconspicuous little buttons are perfectly dead, electrically, until the car touches them. A powerful magnet carried beneath the car serves, however, to close the circuit beneath the metal buttons, whereupon the buttons become suddenly alive, giving what energy is needed to the car. The current thus picked up returns by the regular trolley rails, which thus complete the circuit. The instant the car has passed and the magnet has ceased to influence the metal button armature below the points of contact, the little metal button is left dead once more.

"The metal buttons are in reality the tops of airtight boxes sunk flush with the level of the street. The box itself is about 10 inches square and 2 inches deep. Their mechanism is extremely simple, and therefore unlikely to get out of order. These boxes placed at intervals of 16 feet are in turn connected by an underground conduit, which brings them all into the same circuit. This wire, it will be seen, is completely buried underground beneath the pavement of the street, so that its danger is absolutely nil."

From the above it will be seen that the word "wireless" is not the word to use in connection with this system. There is no such thing as a wireless trolley system in the sense of wireless telegraphy or wireless torpedoes. The trolley system described by the daily in question with a flourish of trumpets as "wireless," is nothing more nor less than an underground conduit system. There are several underground conduit systems in operation in this country and abroad, and about ten or eleven years ago the Patent Office in Washington was flooded with applications from inventors for patents on almost every conceivable idea for operating trolley cars without the conductors carrying the current being visible. Numerous patents were granted, but most of the systems proved defective when given a trial on a practical scale.

* * *

The Welding of Aluminum.

Mr. S. O. Cowper-Coles, at a recent meeting of the Faraday Society in London, introduced some notes on the subject of aluminum by showing that soldered aluminum joints

had proved unsatisfactory, as they will not stand the test of time, because galvanic action takes place between aluminum and solder. One of the chief difficulties encountered other than the formation of oxide in soldering aluminum is, that a few degrees below its welding point it passes into a pasty or brittle state, and being a very good conductor of heat, the solder rapidly cools and freezes before it has time to flow sufficiently. Reference was made to Dick's machine for welding aluminum by the removal of the oxide mechanically, combined with pressure; also to Heraeus' process, which consists in heating the aluminum in a reducing atmosphere until it reaches the pasty stage, when the joint is made by kneading and hammering. The electric welding of aluminum has not proved commercially successful.

The Schmidt electric welding apparatus consists of a carbon stick which is used in much the same way as a soldering iron, by being moved over the portion to be welded to remove the oxide, the aluminum forming one electrode, the carbon stick the other electrode. In Jones' machine for the welding of aluminum tubes, a strip of aluminum is wrapped round a mandrel, and the joints are fixed together by passing a low tension current through the portions to be welded.

Mr. Cowper-Coles described a process of his own which requires no flux or solder, and does not necessitate the hammering of the joint when in the pasty state, the process being especially suitable for wire, rods and tubes. The machine employed is fitted with clamping screws which are controlled by levers. The aluminum is heated by a benzine lamp, and when raised to the point of fusion, pressure is applied to the levers, which causes the aluminum to be welded to unite, a ring of metal being squeezed out.

This ring, which is largely composed of oxide, acts as an insulating and supporting collar, the molten metal being retained within it. Water is then projected on to the point by turning a handle at the same time a screen is moved in front of the flame. The rod is then removed, and when the collar is filed off the joint will be found to be as strong as the rest of the metal. A table was given showing the tensile strength of twelve consecutive welds; in all the tests the specimen broke at some distance from the weld, and in no case did it actually break through the weld.

Now that Mr. Cowper-Coles has devised a process for successfully welding aluminum, the future should see an increasing demand for this metal for long-distance transmission lines.

* * *

An Interesting Struggle.

In the course of a few years New York should abound in rapid transit facilities. We judge this from the fact that at a meeting last week of the Rapid Transit Commission the New York City Street Railway Company, which operates the Metropolitan system, submitted its plans for tunnel extension. The Interborough Company, which will operate the main subway, has already submitted plans to cover the same territory. Upon the inducements offered by both corporations will depend the decision of the Rapid Transit Commissioners as to which will be allowed to construct the new road.

The first mentioned company offers to build an electric railroad subway from the Battery to the Harlem River, touching the surface system at such important points as the new Pennsylvania Railroad station and the Grand Central station. The exact route of the Metropolitan's proposed tunnel is up Greenwich street, under Hudson street, under Eighth avenue, connecting with the Pennsylvania station tunnel at 32d street; thence across town, touching at 42d street, and under Lexington avenue to the Harlem River.

The extension proposed by the Interborough Company contemplates two branches. That on the east side is to connect with the present system at Park avenue, just south of 42d street, to run east to Lexington avenue, thence up Lexington avenue under the Harlem River. That on the west side will make a connection with the 42d street line, to run down Broadway to Union square, and thence south under University place, West Broadway and Greenwich street to the Battery.

The Interborough Company will give transfers from any part of its new subway to the elevated railroad at any point. The Metropolitan can perfect an elaborate system of transfers with its crosstown lines and can probably arrange for a cheaper fare over the lines of the Union Railway Company in the Bronx. As an offset to this the Interborough will probably have the advantage of Brooklyn extensions, which the Metropolitan does not yet possess. This will prove a strong argument in its favor, although the Metropolitan system of transfers in Manhattan will be able to touch more points than the Interborough can effect by means of the elevated railroad.

Whichever company finally wins out, one thing is certain—residents of Greater New York will get far better transportation facilities than they have had heretofore, and the city will get reasonable terms.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The London correspondent of the New York *Times* writes: "There are over 10,000 omnibuses in operation in London, which it is desired to put aside. What a field for an electric motor! The omnibus company does not care a fig what country furnishes the invention it earnestly desires to use in its great business. I wonder if an American cannot do the job!"

Prof. Dr. Markwald, of Berlin, is reported, according to a foreign contemporary, to have discovered a new radioactive substance, which he has named radio-tellurium. Before an audience of the leading scientists of Vienna, the professor said that in experimenting with pitchblende from Joachimsthal, Bohemia, he discovered minute quantities of a very active substance which at first showed all the reactions of tellurium, but further examination proved it to be a mixture of tellurium and most minute quantities of a substance hitherto unknown.

The Navy Department is making preparations to transfer the wireless telegraphy school for enlisted men from Newport, R. I., to the Navy Yard at this city, where better facilities are afforded for this work. It is intended to assemble here all men under electrical instruction, both in wireless telegraphy and other branches.

Architects and electrical engineers of Washington, D. C., held a joint meeting recently, and discussed questions of interest to both professions. Dr. F. A. Wolff, president of the Society of Electrical Engineers, occupied the chair and Philander Bettz acted as secretary. Six papers were read, showing the intimate connection between electrical engineering and architecture.

Additional discoveries of large deposits of rare earths and minerals containing radio-active preperties are reported from the Llano mineral district near Austin, Tex. Gadolinite and yttria are being mined there, and large quantities of the gadolinite is shipped East where it is utilized for making the filament or glower of incandescent gas burners and electric lamps.

MODERATE AND STEEP GRADES ON FOREIGN MOUNTAIN ELECTRIC RAILWAYS.

BY FRANK C. PERKINS.

Electrically operated railways having very steep grades are successfully operated in this country as well as in Europe without making use of the rack system. Electric power seems to be particularly well adapted to mountain roads the same as railways having frequent short steep grades to surmount. The cable railway has almost entirely given place to electric traction in cities even where the grades are very heavy. The polyphase alternating current system is used largely in Switzerland on the mountain roads both of ordinary track construction and using the rack system in extreme cases. The Jungfrau Railway has grades exceeding 25 per cent. which are easily taken at normal speed by the three-phase locomotives, and the Zermatt-Gornergrat Mountain Railway is another rack road which has grades of 20 per cent., the latter being 3,020 meters above the sea level.

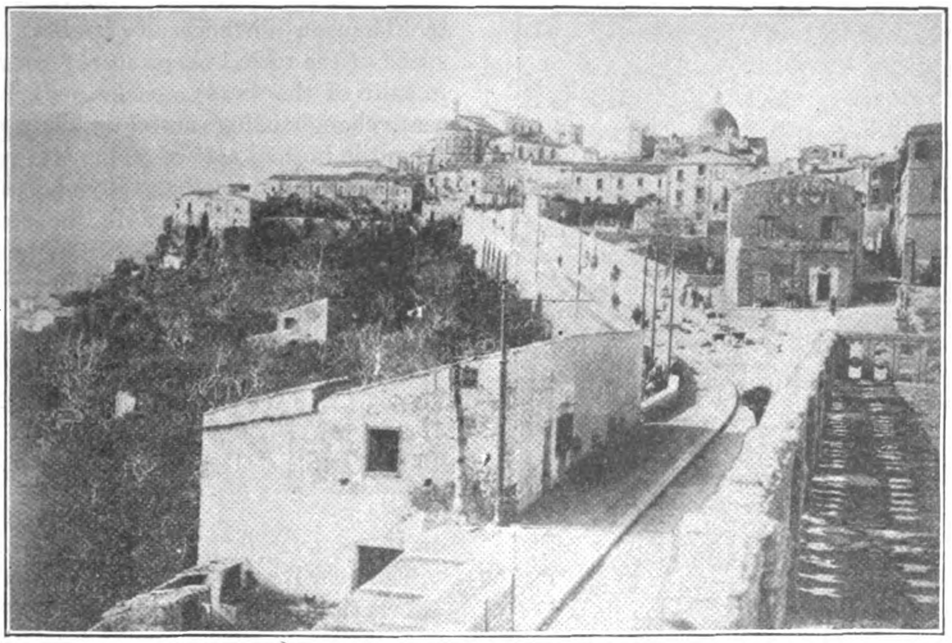

Fig. 1.—View of Palermo Electric Railway.

The accompanying illustration, Fig. 1, shows the moderate grade of the Palermo Electric Railway at Rocca Monreale. This railway was equipped electrically by the Schuckert Company of Nurnberg, Germany, who also supplied the high tension 20,000 volt generators at the power house at Morbegno which supplies three-phase current for the operation of the Valtelina Railway in Italy, shown in Fig. 2. The electric locomotives for this Italian railway were constructed by Ganz & Co. of Buda-Pesth, Austria-Hungary, and are of 600 hp. output and capable of handling trains of 200 tons on grades of 10 per cent. at normal speed without difficulty. These locomotives take the current from the overhead trolley wires at a pressure of 3,000 volts, this tension being obtained by means of step-down transformers, reducing the 20,000 volt transmission current to 3,000 volts for use on the working conductors.

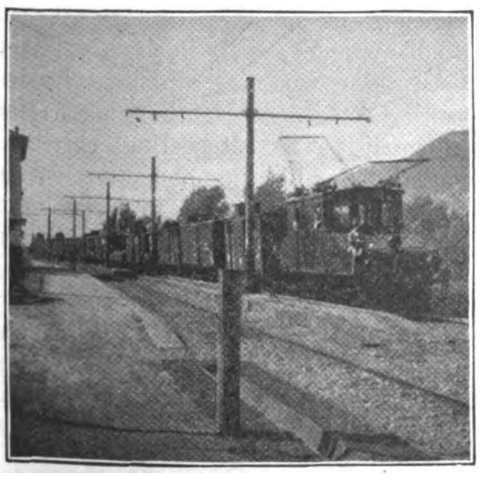

Fig. 2.—Electric Locomotive Freight Train on Valtelina Line.

The total length of the Valtelina Railway is somewhat more than 70 miles and both freight and passenger traffic are very heavy at certain seasons of the year. The normal speed of the freight and passenger trains is 18 and 36 miles per hour. In case an overhead wire is broken or if a section is intentionally cut out to prevent a train from passing, an automatic brake has been devised to stop the train at once. In case the trolley of the locomotive jumps the wire the pole is automatically drawn down immediately by the operation of an air valve which opens automatically and thus supplying the necessary power from the air compressor tank.

It is interesting to note that the track and line are entirely cut off from the 3,000 volt working current except at the time of the passage of the train, at all other times being normally cut out of circuit,

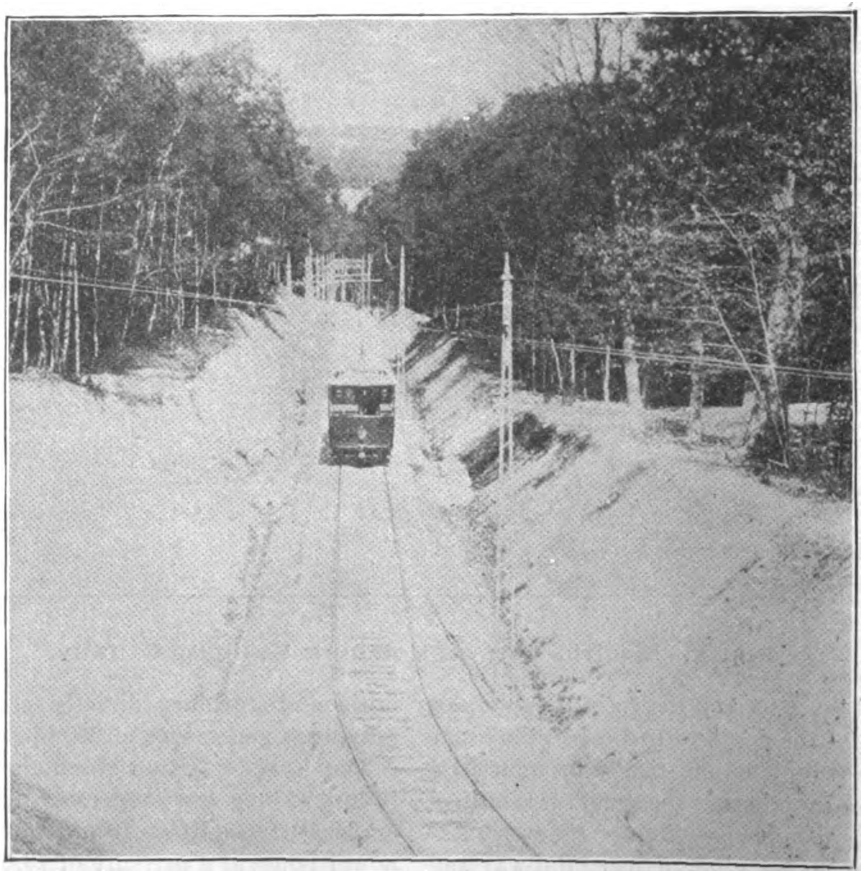

Fig. 3.--Electric Car on Homburg-Saalburg Line.

Unless the air brakes are in proper working condition it is impossible for the train to move for it is not possible to obtain current from the trolley wires unless the right air pressure is provided in the air brake cylinder, which allows the trolley poles to rise and meet the trolley wires to receive the current from the line. If a signal is set to stop the train it is impossible for the engineer to disobey the order as the train is automatically brought to a stop and the brakes set should it continue on the forbidden section.

The Stansstadt-Engelberg Railway and the Bergdorf-Thun Mountain Road in Switzerland were installed by Brown, Boveri & Co. of Baden, Switzerland. On the former line there is a particularly steep grade between the Obermatt power station and Grunwald and Evitement Cherst. The Stansstadt-Engelberg electric road is 22½ km. long and has three locomotives each equipped for the heavy gradient with two 75 hp. motors of the three-phase type. The current is supplied from a hydro-electric plant equipped with horizontal turbines directly coupled to polyphase generators of 600 hp. capacity

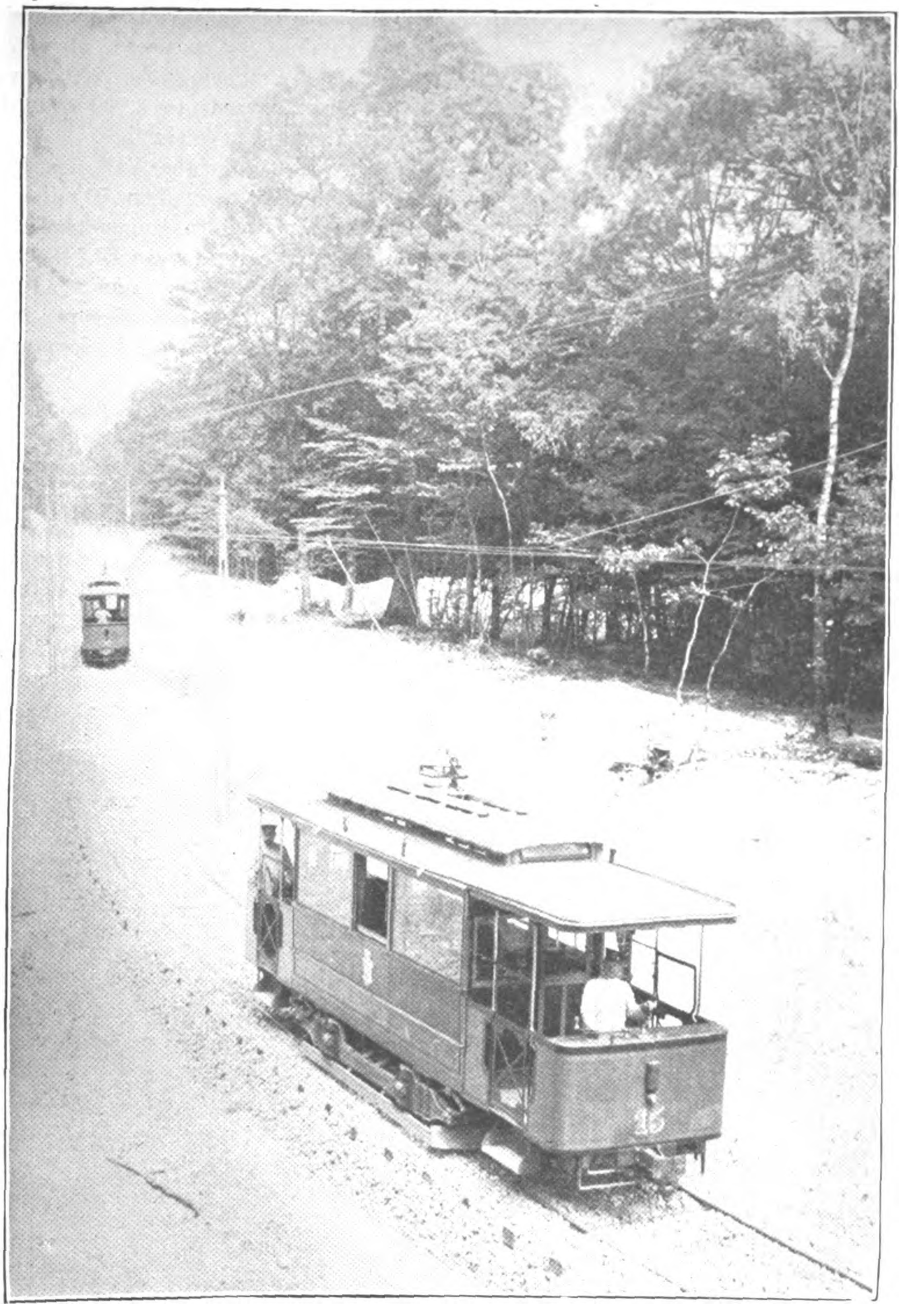

Fig. 4.—Electric Cars on Homburg-Saalburg Railway.

The Burgdorf-Thun Mountain Railway is 40 km. long and is operated by electric current transmitted from the Kander power house at a pressure of 16,000 volts. This high tension current is reduced at substations along the line to 750 volts for the overhead working trolley wires. The locomotives are equipped with two 150 hp. motors and are capable of hauling a maximum train weight of 70 tons up the steepest grade of 1 in 40 at half speed and a load of 50 tons at normal speed. The locomotive weighs 30 tons, making the total load 100 tons for the train. There is a continual up-grade the whole distance from Burgdorf to Gross-Hostetten., about 16 miles, and a heavy down grade to Thun, a distance of 9 miles. The speed of the train is kept nearly constant in spite of the heavy grades, only 2 per cent. change being noted on the grades from the normal rate of 39 km. per hour.

The Homburg-Saalburg Mountain Electric Railway is illustrated in the accompanying figures, 3 to 5, while Fig. 6 shows a car on a steep grade of the Elektrische Strassenbahn Heidelberg-Wiesloch.

DOUBLE CURRENT GENERATORS IN THEIR CONNECTION WITH DOUBLE CURRENT SUPPLY.*

BY W. L. WATERS.

The relative advantages of direct and alternating current supply are now pretty well known. The great advantage of alternating current is the ease with which high voltages can be handled and the facility with which the voltage can be transformed by means of stationary transformers. The chief disadvantage is that it is unsatisfactory for street railway work and for elevator and variable speed motors. With direot current, exactly the reverse is the case. It is unsuitable for high voltage work, but gives good results for all classes of motor work. The obvious result of this has been to have double current supply in situations where both these advantages and disadvatages are important. This usually means that in small towns alternating current is supplied for lighting and direct current for traction work, while in larger towns direct current is supplied for the downtown districts, where the motor load is important, and alternating current for up-town districts, where the load is almost entirely a lighting load. Thus we very often have both alternating and direct current supply from the same power station.

The question of double current supply from one station is usually settled by having both alternating and direct current sets, each set generally having its own engine. This solution is hardly regarded as satisfactory, because the motor load being a maximum load during

*Paper read at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

the day and a lighting load a maximum in the evening, it means that we have the alternating current sets idle during the day and the direct current sets idle in the evening, so that we have only about half the plant in use at one time. It is obvious that a saving in first cost and in operating expense will occur if the two systems are tied together in some way so that they can help out one another at times of heavy load. This can be done by having both an alternator and a direct current generator coupled to one engine, or by having double current generators, or by tying the supply circuits together by rotary converters, or motor generator sets.

From the point of view of the station engineer the double current generator ought to be the best solution. The efficiency is higher than when rotary converters or motor generator sets are used, and it ought to be considerably cheaper than either of the other methods. The main objection to it is that the voltage on the alternating current side of the machine bears a definite ratio to that on the direct current side, so that one can not be varied without the other, and that variation of the load on one side effects to a slight extent the voltage on the other side. The relative importance of these objections has, of course, to be decided in each individual case.

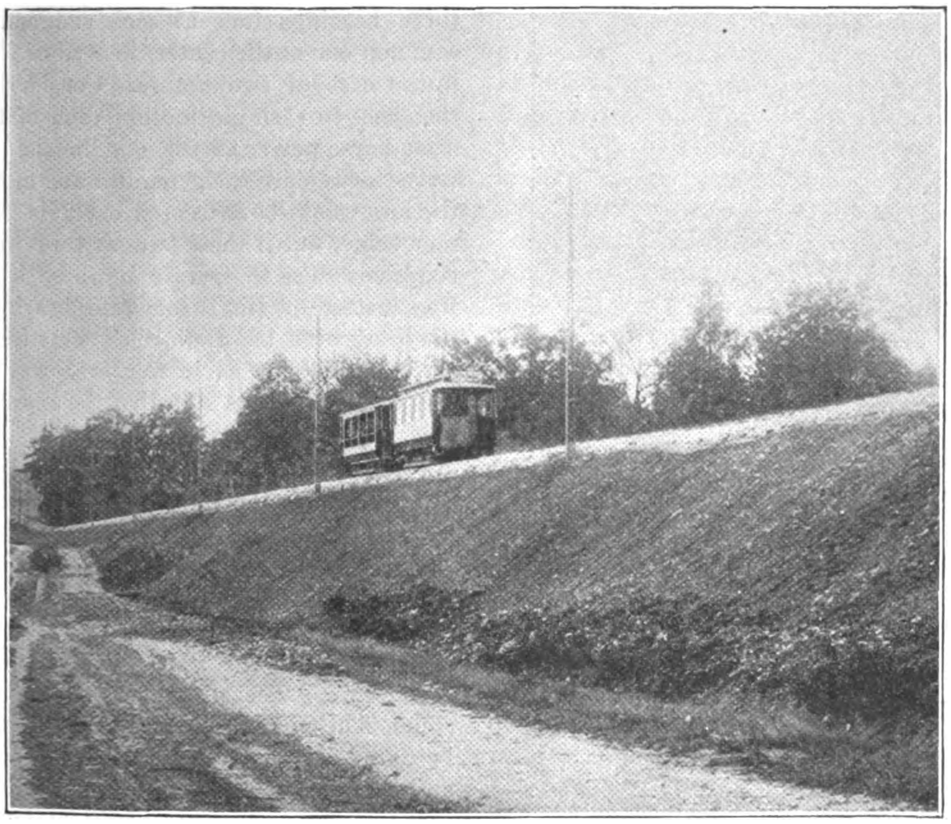

Fig. 5—Electric Cars on Steep Grade of Homburg-Saalburg Mountain Railway.

From the manufacturer's point of view the great objection to double current generators is that they are special machines and usually require new designs and special patterns and dies, and for this reason you will usually get very little encouragement from the manufacturer when you suggest double current generators, and if he takes the order at all, it will be at a fairly high price.

Of course, we can take any direct current machine and provide it with collector rings and get alternating current from it, but the difficulty is usually that the frequency is unsuitable. An alternator can be built for any commercial frequency and speed and voltage without any serious difficulty, but in a direct current generator, given the speed, voltage and output, the question of commutation and cost decide the number of poles, and hence indirectly the frequency. If this number of poles has to be changed considerably in order to obtain a different frequency there is often considerable trouble with the design, and this usually means increased cost. So if some latitude can be allowed in choosing the frequency and speed for the double current generators it is advisable to choose them so that, if possible, the generator does not differ very much from some standard direct current machine.

The following table gives the frequency of the alternating current that could be obtained from standard direct current generators. The number of poles, and the speeds of the machines are taken from those of the National Electric Company, but there is so little difference in these respects between the machines of the various companies that they can be regarded as applying to all standard makes of generators:

	Engine Type.		Belt Driven.		Steam Turbine Driven	
Kilowatts.	250 V.	500 V.	250 V.	500 V.	250 V.	500 V.
25	15	15	40	40	......	......
50	14	14	33	33	......	......
100	13	13	35	35	60	60
250	12	8	27	23	60	60
500	12	8	31	25	80	60
750	14	10	......	......	...	70
1,000	15	13	......	......	......	......
1,500	20	16	.....	......	......	......
2,500	22	18	......	......	......	......

If we took as standard frequencies for double current generators 25, 40 and 60, we see that some of these standard direct current generators could be very conveniently used as double current generators, with only a very slight change in the speed. A standard 2,500 kw. 250 volt engine type machine would make a very good 25 cycle double current generator, the only change being to provide the machine with collector rings, and to increase the air gap and put more copper on the field magnets in order to make the machine regulate properly when running as an alternating current generator. These changes would not increase the cost of the machine more than 20 per cent. On the other hand, if we took a 500 kw. 500 volt engine type machine it would mean very radical changes to make this into a 25 cycle double current generator. The number of poles would have to be increased from 10 to 24 or 30, which would mean nearly doubling the cost of the machine, but if we make this 500 kw. machine belt driven, instead of engine type, we can see from the table that a standard machine would give 25 cycles.

Twenty-five or forty cycle machines are not in any way difficult to build, at the most it is simply a question of special designs and patterns. But with 60 cycle generators we begin to have difficulties with the commutator on account of the high peripheral speed. Sixty cycle, 600 volt double current generators and rotary converters can be made to work, but they are not such reliable machines as those for lower frequencies, and there is no brush gear at present on the market which is quite satisfactory for the commutator peripheral speeds necessary in a 60 cycle 600 volt machine.

The higher the speed of a standard direct current machine of a given output the higher the frequency; thus we would expect that the higher the frequency of a double current generator the higher the

speed at which it should run, and it appears from the table that the most satisfactory 60 cycle double current generators will be those driven by steam turbines. Direct current generators suitable for being driven by steam turbines are not at present on the market, but in all probability they will be so shortly, and it looks as though they would solve the problem of 60 cycle double current generators.

Generally speaking, then, 25 cycle double current generators if of large size, can be direct connected to the engine, while for smaller than 500 kw. they are better belt driven. Forty cycle machines should always be belt driven if the cost is to be reasonable, while for 60 cycle double-current generators, apparently the only reasonable solution is to have steam turbine driven sets. Of course, double current generators can be made for any frequency and voltage up to 60 cycle 600 volts, and at any speed that you wish; it is simply a question of dollars and cents; but if you wish to get the most reasonable prices and the quickest deliveries and to have machines which when second hand will be worth something more than scrap, then you would be well advised to pay attention to the table of frequencies and outputs when laying out a station for double current supply.

It is claimed that a fair showing of success has been made by the only system of trackless trolleys in the United States, located at Scranton, Pa.

ELECTRICAL STATION PRACTICE.

ARTICLE XXVI.

BY W. H. RADCLIFFE.

In the two preceding articles have been shown the simplicity and efficiency of transformers for changing alternating currents of one voltage into alternating currents of a different voltage. It is also possible to alter direct current voltages in this manner, but instead of a stationary piece of apparatus simple in construction, there is required two rotary machines each of which approaches in complexity the average direct current generator in commercial use. In other words, there is required a motor-generator set, which as its name implies consists of two components—a direct current motor and a direct current generator each complete in itself but acting as a single machine owing to their respective armature shafts being directly connected and their respective field frames being mounted upon a single base.

Fig. 6.—Electric Car on Heidelberg-Wiesloch Line.

There is a similarity between the alternating current transformer previously described and this direct current transformer in that the function of the primary winding in the former corresponds to that performed by the generator of the latter. The line wires supply the primary current for running the motor, and the power derived from its armature is used to rotate the armature of the generator, which latter machine is designed to develop current at the desired voltage. Owing to the fact that the motor and the generator are in practice connected to entirely separate circuits, the ratio of transformation is not limited in any respect and may therefore be made whatever the existing conditions necessitate. There is, however, a certain loss in the process which is approximately equal to the loss occurring in two motors each having a capacity equal to that of the motor used in the set. This approximation is based upon the fact that direct current motors have usually somewhat lower efficiencies than those of direct current generators, while the friction loss of two motors operating singly would ordinarily be a trifle greater than that in a motor-generator set since in the latter machine there is usually three bearings (one at each end and a common one at the center) instead of four in the case of two motors. Considering then the two single motors each of the same horse power as the one in the set were to replace the generator and motor the loss would be increased over its former value, but if these two motors were combined so as to operate in three bearings instead of singly on four bearings, the loss would be diminished practically the same amount as it formerly was increased. It is thus seen that the approximation is not far in error.

Either the shunt or series wound type of motor may be employed at the power producing end of the set, but the field of the generator is either shunt or compound wound, depending upon whether or not it is desired to maintain or to raise the secondary voltage near full load. In either case a rheostat introduced in the shunt field winding of the generator will be found very essential. Both generator and motor are so mounted on the base that their respective commutators are at the outer ends of the set; by this means ample space surrounds all of the working parts, and repairs can readily be made.

Motor-generators are frequently used as boosters to raise or boost the voltage near the extremities of long distance, direct current, transmission lines. Of these, electric railway systems of moderate size in which it is desired to extend certain of the longer lines, form a typical example. Owing to the great cost of changing the system over to one employing alternating current, or storage batteries, or of constructing an additional power station, these solutions of the problem are usually at variance with good judgment and the amount of money at hand. The choice then remains between the purchase of additional wire for

feeders, the connection of a booster in the old feeders, or the installation of both larger feeders and a booster. Of these, it is generally found that either the second or the third mentioned alternative meets the conditions most satisfactorily.

A booster when installed in a railway system for the purpose just mentioned would have a series wound motor, and the circumstances to which it must conform would be as follows: The motor having a series winding, must provide for the full feeder current passing through both armature and field windings. Owing to the varying loads on a railway system due to the frequent starting and stopping of cars, the feeder current varies between zero and some such value as 150 amperes. This fluctuation of current through the field winding, will in ordinary cases vary the magnetization of the pole pieces from zero almost to the point of saturation; that is, the maximum feeder current will so nearly fill the magnet cores with lines of force that it would be quite difficult to cause more lines of magnetic force to pass through then. So long as the point of saturation is not reached, however, the proportion of amperes to field strength remains constant, and therefore the ratio of amperes to volts does not vary. The severe fluctuations of the feeder current would, if the motor were shunt or compound wound, cause most serious sparking and various other troubles, but in a series motor where the back ampere-turns on the armature that react on the field vary in precisely the same proportion as the ampere turns in the field, there exists at all times a tendency to balance the active forces and produce satisfactory operation. If, however, the field magnet cores are very large they cannot so quickly respond, magnetically, to changes in the strength of the current and there is therefore greater liability of the armature reaction momentarily weakening the field and thereby producing temporary sparking.

Motor-generators are not always composed of direct current machines, although when used as boosters on electric railway systems they must necessarily be of the direct current type. For other purposes, however, where direct currents of widely different voltages are to be obtained from an alternating current circuit and it is desired to install but one set, a motor-generator consisting of an alternating current motor such as the induction motor, and a direct current generator, must necessarily be employed. In such motor-generator sets it is not uncommon to find both motor and generator armature mounted on a common shaft and the respective field frames resting on a single base, although for connection on a very high pressure alternating current circuit separate armature shafts insulated from each other but directly connected together, and separate bases resting on a single foundation, are usually employed to afford the highest degree of insulation between the respective circuits of the two machines.

The commercial field that would naturally be covered by a motor-generator set composed of an alternating current motor and an alternating current generator, is far better supplied by a transformer such as was discussed in the two preceding articles. Since a transformer contains no moving parts it is simpler in construction, cheaper in price, and less liable to get out of order than a motor-generator; it is, therefore, used in place of a motor-generator whenever conditions necessitate the transforming of an alternating current of one voltage into an alternating current of a different voltage.

A machine performing the same function in a sub-station as a moter-generator transforming direct current of one potential into direct current of another potential, but of a more compact form, higher efficiency, simpler construction and less cost, is the dynamotor. A dynamotor differs from a motor-generator in that the motor armature and the generator armature are combined into one thereby requiring only one field frame. Since the motor and generator windings are mounted on a single core, the armature reaction due to the one winding is neutralized by the reaction caused by the other winding. There is, consequently, little or no tendency for sparking to occur at the brushes and they therefore do not need to be shifted on this account for different loads.

A dynamotor is usually constructed with two pole pieces which are shunt wound. Owing to the impossibility of having these pole pieces compound wound, the voltage developed falls off slightly under an increase of load, and herein lies one of the disadvantages of this type of machine. The armature, as previously stated, consists of two separate windings, one of which is joined to a commutator mounted on one side of the armature for motor purposes, and the other winding is joined to the commutator on the other side of the armature for generator purposes. By means of two studs of brushes pressing on the motor commutator, current from the service wires is fed into the winding connected to this commutator, and since the shunt field winding is also excited by the current from the service wires, there is developed in the generator winding on the rotating armature a direct electromotive force which is proportional to the speed of rotation of the armature in revolutions per second, the number of conductors in series which constitute the generator winding, and the total strength of the field in which the armature revolves. This electromotive force causes current to pass through the generator winding and the distributing circuit when the distributing circuit to which this winding is connected by means of its respective commutator, brushes, etc., is closed.

The dynamotor having shunt wound field magnets is connected at its motor end and started in precisely the same manner as any shunt wound motor on a constant potential circuit. The necessary precautions are, therefore, to have the poles strongly magnetized before passing current through the motor winding on the armature; to increase gradually the current through this winding, and not to close the generating circuit until normal conditions regarding speed, etc., are established in the motor circuit. Regulation of the current developed in the machine can only be obtained by the introduction of resistance in one or the other of the armature circuits, or by a shifting of the brushes around the commutator. As previously stated, however, dynamotors are more efficient than motor-generators of a similar type. This is owing to their having but one field circuit, and also on account of there being at least one less bearing, the dynamotor having but two bearings, whereas a motor-generator requires at least three, and occasionally where two entirely independent machines are directly connected together to form a motor-generator, there are four bearings.

RECTIFIERS.*

BY PROF. CHARLES F. BURGESS

(*Concluded from page 109.*)

While the efficiency of the rectifier is such as to enable it to compete very satisfactorily with a motor-dynamo or similar form of charging device when small outputs are required, for larger equipments of say 5 to 10 kw., the advantage or efficiency is in favor of the latter device.

The electrolytic rectifier will not operate indefinitely without attention, for there is a tendency to electrolytic decomposition, for the liquid to evaporate, and for the electrodes themselves to undergo

* Paper read at the twelfth annual convention of the Northwestern Electrical Association held at Milwaukee Wis., Jan. 20-22, 1904.

a certain corrosion which requires their replacement after certain intervals. With certain forms of cells, however, this corrosion and the amount of attention made necessary may be rendered so small as to offer little ground for practical objection.

In some extensive tests on a form of rectifier devised in our laboratory we have found that the total cost of maintaining the apparatus in working condition may be covered by a small fraction of a cent per kilowatt hour, and the amount of attention is limited to a few minutes once in each ten hours of continual operation.

Another limitation of the rectifier is due to the pulsating nature of the rectified current. Pulsations of the current while interfering in no way with its use for charging batteries or for other electrolytic work may produce a humming sound and heating due to eddy current in motors which are operated by this current. There is also produced a very undesirable humming sound in telephone lines which are operated from batteries simultaneously under charge by this pulsating current.

In measuring the efficiency, and investigating the properties, of this new type of apparatus certain peculiarities become manifest. On attempting to measure the output of these rectifiers by the use of direct current ammeters and voltmeters, and multiplying the readings thus produced to give the watts, a value considerably at variance with the true value may be obtained on account of the failure of the ordinary type of instruments to properly record the current having this peculiar pulsating nature. The wattmeter, however, will give more nearly correct indications and the efficiency should be properly determined by wattmeter readings on each side of the rectifier outfit. It might at first sight seem rather startling after measuring the rectified pressure by means of a direct current voltmeter and obtaining a reading of say 25 volts, to find that when connecting a 28 or 30 volt storage battery to the terminals, a charging current will flow. This, of course, is due to the fact that the voltmeter indicates only average values of current while at certain portions of the current wave the pressure considerably exceeds this value. It is while the pressure is at the maximum that the storage battery in the above instance will be charged.

Electrolytic rectifiers may properly be subdivided into two classes, one in which an aqueous solution is employed and another in which use is made of the non-aqueous or fused electrolyte. It has been found that certain soluble phosphates, borates, tartrates, sulphates and various other materials when placed in water to a suitable density will cause aluminum to develop the valve action. It has also been found that in most of these solutions if the temperature be allowed to rise beyond 30 or 40 degrees C a marked decrease in efficiency results, and it is, therefore, necessary in cells of any considerable size to use a cooling device in which the cell is kept at a low temperature either by flowing water or circulating air.

Mr. Carl Hambuechen, of the University of Wisconsin, has discovered that aluminum acts most efficiently as an asymmetric conductor when placed in molten sodium nitrate, or certain other similar salts. Upon this discovery is based the second class of electrolytic conductors, or those which employ the fused electrolyte. An average efficiency of from 10 to 30 per cent. higher than that of the aqueous type may be maintained with the fused salt on account of the more efficient valve action of the aluminum and the lower resistance of the electrolyte. It has a further advantage in that the development of heat is utilized, inasmuch as it tends to keep the material in a condition of fusion and at a high degree of conductivity, while with the aqueous type, the elevation of temperature beyond 30 or 40 degrees C. causes such a rapid decrease in efficiency that artificial means are necessary for dissipating the heat.

With the fused salt the temperature of operation is limited to the degree of heat at which evaporation and decomposition of the electrolyte begins, and this point being over 350 degrees C. allows a fairly high rate of radiation by simply exposing the cell to the air. This fact, together with the high conductivity of the fused salt, enables a large output per unit of weight and volume of the cell to be attained.

The essential parts of this rectifier consist in a specially wound transformer or auto-transformer which allows connection to a 110 volt or other convenient source of alternating supply. This transformer has various terminals by means of which the ratio of transformation and consequently the pressure of the rectified current may be regulated, thus avoiding rheostat control. Connections are made also from the windings of the transformer to two aluminum electrodes and an iron electrode. The electrodes are contained in an aluminum case surrounded by an asbestos cover, passing through and being held in place by a stone top.

When the rectifier is not in use, the electrolyte is perfectly solid and non-conductive, but by passing a low voltage and high volume alternating current lengthwise through the iron electrodes for four or five minutes the cell is brought into working condition, after which the heating current is switched off, and the cell is maintained at the desired working condition by the natural heat losses when operating within 25 per cent. of the normal load.

With aluminum electrodes 2 x 1 inch x ¼ inch, the normal load is 10 amperes, at a rectified pressure of 25 to 30 volts. The current may be several hundred per cent. higher than this value for a short time without detriment, and a 50 per cent. overload causes excessive heating and vaporization of the salt only after several hours run. The total weight of an output of this capacity is about 30 pounds, most of which is in the transformer.

All the attention which the device requires is the addition, once in each day of operation, of a small amount of salt in the form of sticks which are introduced through an opening in a stone cover. This salt is added for the purpose of supplying electrolyte losses by vaporization, and neutralizing the tendency of the electrolyte to become alkaline by the decomposition effect of the current.

By thus maintaining the salt in working condition, aluminum electrodes have been operated for over 800 hours without excessive corrosion and the iron electrodes last a considerably longer time. Estimates of the cost of the additional salt and the renewal of electrodes place the figure at below three tenths of a cent. per kilowatt hour.

The electrolytic rectifier in its present stage of development is an apparatus of interest and value to the central station manager as well as to the large number of customers who desire to obtain from existing alternating current systems current for their electric automobiles or for storage batteries used for other purposes.

If it comes into extensive use some interesting problems will be presented to the central station manager. The customer who connects his rectifier to the regular lighting circuits pays a high price for his power. It is doubtful whether even at this rate such a load is a desirable one from the station standpoint on account of its intermittent nature, and its interference with the regular lighting service. The management, however, could well afford to encourage the use of the rectifiers in the daytime to the extent of giving reduced rates for that portion

of the day when the tax on the lighting circuits is at the minimum.

The improvements in quality and price of storage cells, and the many new uses for them, tend to increase the importance of any device which will enable them to be charged from alternating circuits, and the rectifier may serve not only to add to the accommodation that can be offered to the customers, but also to afford an additional market for the central station product.

DASH POTS FOR CORLISS ENGINES.

ARTICLE I.

BY W. H. WAKEMAN.

The Corliss valve gear in operation never ceases to be a mystery to those who are not engineers or mechanics, especially the dash pots, which are frequently called pumps by people who know just enough about machinery to think they know a pump when they see one.

A dash pot slightly resembles a single acting pump, but there is a great difference between them in operation, for while the pump performs its useful work on the upward stroke, the dashpot does its duty on the downward stroke.

Dash pots increase the efficiency of every engine to which they are applied, and in modern practice they are not only an economical appliance, but an absolute necessity.

Fig. 1 illustrates a Corliss valve gear with dash pots in operation. The dash pot rod 2 is connected to the valve crank 3 and this crank has just been disengaged from the hook 4. The plunger in the cylinder 5 by means of the rod 2 draws the crank valve 3 to its lowest position, as shown, the instant that it is released from 4. When 3 is in the position shown the steam valve on the crank end is closed. There are two objects in using a dash pot, one of which is to close the cut-off or steam valve as soon as steam enough to complete that stroke has been admitted, and the other is to close it as rapidly as possible.

If an engine is run at a very slow speed it appears proper to close the valves slowly, but this is a mistake because the rate at which the valves close should be independent of the rate at which the piston travels.

When we consider the reason for opening and closing steam valves quickly, the reason for an independent rate will be apparent. When steam is wire drawn, or in other words, when its pressure is reduced by causing it to pass through a small passage, its efficiency is reduced. For this reason engine builders seek to admit steam as quickly as possible at the beginning of a stroke, and when enough has been admitted to cut off the supply as soon as possible. This is one reason for the economy of the Corliss engine in the use of steam.

The wrist plate motion opens the valves rapidly, the governor indicates the point at which steam shall be cut off and the valve crank is disengaged. The dash pot then performs its duty and the valve is closed quickly. Of course this action is repeated more times per hour where the speed is high, than in cases where it is low, but this is the only difference, so far as the prevention of wire drawing is concerned.

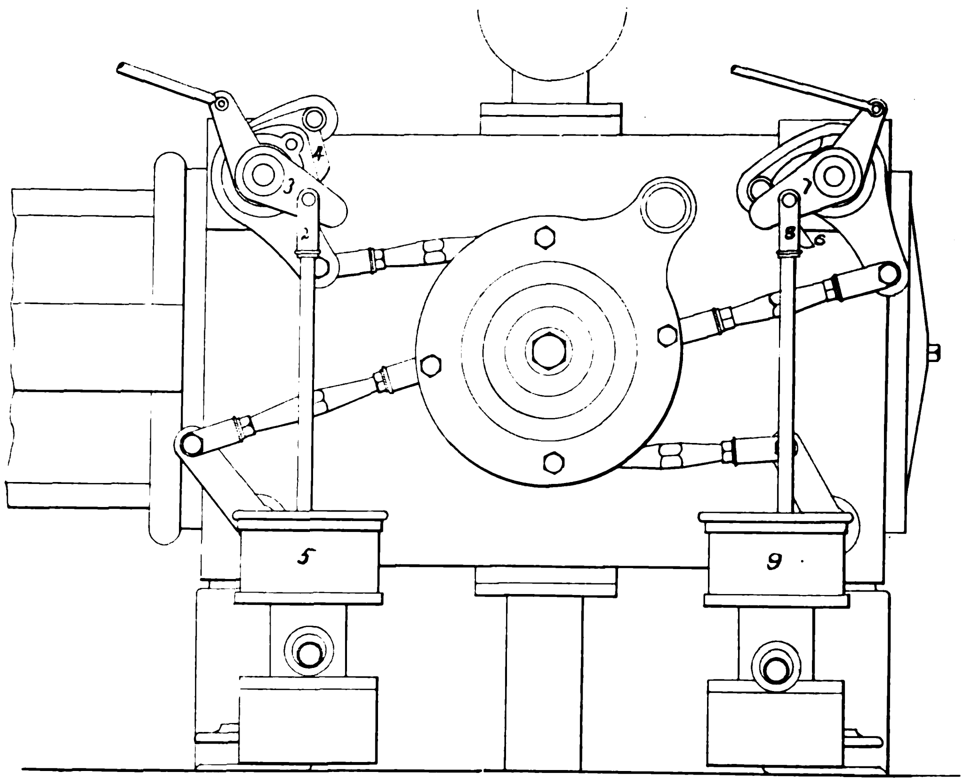

FIG. 1.

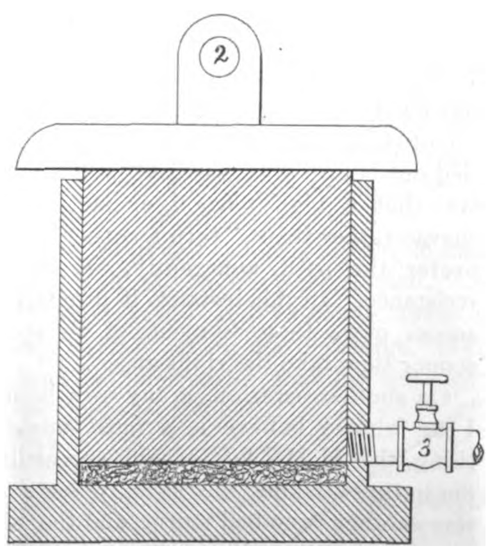

FIG. 2.

Again referring to Fig. 1, it will be noted that the dash pot plunger on the head end is also in its lowest position, corresponding to that of the other, but its relation to the wrist plate and its connections is far different.

The cross-head of this engine is traveling towards the cylinder, and the piston is near the cylinder head, therefore the crank end dash pot has been at rest for some time. The wrist plate has reversed its motion and is now traveling from right to left. The hook or latch 6 is about to engage the valve crank 7 and raise it together with the dash pot rod 8 from the position of rest which it now occupies. This will raise the plunger in the cylinder 9 until the valve is tripped, when this plunger will quickly close the valve and the operation is repeated indefinitely.

It was formerly considered that from 60 to 75 times per minute was the limit of speed at which a dash pot plunger could be made to operate, and when we consider the kind of dash pots they used (for lack of something better) its limitations are understood. By the use of improved designs and devices, the possible rate of operation has been raised to 200.

The lower rate is much more desirable from the working engineer's point of view, as the wear is much less and its action less noisy.

Fig. 2 is an old-fashioned dash pot that is still in use in the immediate vicinity of my engine room (but not in it) on an engine that was built in 1855 and is still doing good work. It rises and falls 67 times per minute.

The dash pot rod is fastened to the

plunger by means of a pin passing through 2 and the operation of this kind of a dash pot is as follows: As the plunger is raised by the valve gear, air rushes in through the valve 3, which is left partly open for this purpose, and fills the cylinder below the plunger. As soon as the crab claw, latch or hook (according to the style of engine) is unhooked from the valve crank, the plunger begins to descend, but it meets with some resistance, because the air below it cannot escape through the valve 3 fast enough to give it a free passage. It is therefore cushioned and brought to rest easily as a rule, but as a precaution against pounding, a piece of leather is fitted into the bottom of cylinder as shown in the cut.

A dash pot of this type, as made for practical use, never did close a valve rapidly, viewing the matter from a modern standpoint, and there is one reason why it never will.

It is possible to make a plunger heavy enough to drop very quickly, the instant it is released, but its great weight would make it impractical to start it from a state of rest, for it must be remembered that it is always started with a sudden jerk and not with an easy motion. Excessive weight here would cause excessive wear on the entire valve gear, making it noisy and liable to sudden failure when most needed.

LIGHTNING AT CLOSE QUARTERS.*

BY FRED. H. HADFIELD, M.I.E.E.

Possibly many others of our profession, readers of this, may have seen or experienced the awe-inspiring effects of lightning at close quarters; for myself, I have done so too often for my peace of mind, and in that country where its effects seem most marked—South Africa.

I have had the opportunity of seeing there, close to the Berg, the mountain range between Natal, and what used to be the Free State, the sky turn to a ghostly greenish hue, the wind rise in the space of a few minutes to a shrieking hurricane, almost overturning the post cart, and the thunder roar apparently in your very ears, while the lightning struck the ground and sent the boulders flying—a veritable inferno; while a short distance off it struck the trek chain of an ox wagon, killing every unfortunate beast.

And I have been nearer than this. Some years ago I had occasion to be working in a shop where I had a small steam engine running a dynamo and a line of shafting driving machine tools. As I wanted all the available power on the shafting, I went up to the roof to disconnect the coupling joining the two halves of the shafting, sitting on a plank while I took out the bolts. I had casually noticed that there was a storm about, but did not connect it with my present job. I had just finished disconnecting, and had levered back the coupling a couple of inches, sitting with my knees not 6 inches away, when, with a deafening noise, a most appalling flash passed across the gap between the coupling; the roar of the thunder, the noise of the falling iron chimney, the yells of some natives outside, and the sort of phosphoric stench one always gets on these occasions, came all together. I am not a particularly nervous subject at any time, and have been in peril of my life quite a dozen times, but nothing has so completely demoralized me as that flash. I absolutely had not the control of my muscles for some moments to remove myself from further danger.

I found the discharge had struck the iron chimney, riddling it with holes and knocking off the top length, gone through the iron roof, jumped thence to a large pulley, arched over the gap between the halves of the coupling along the shafting, thence to a 400-gallon iron tank outside full of water, and to earth through the water main.

On another occasion, many years ago, I had been inspecting a telephone, and a bad storm came on. I have found it convenient on these occasions to leave telephones alone, so I sat outside on the veranda watching the storm. The earth wire from the instrument was of stranded iron, and came out under the veranda and took a right-angled turn before going to earth. This was about 6 feet from me. Suddenly the lightning struck the iron rod on the roof carrying the insulator, demolished the telephone, and I saw carried out before my eyes the well-known law that a high tension, or static, discharge rather than "turn a corner," will prefer the path, apparently, of greater resistance. In this instance it discharged across more than 40 inches of air space sooner than take the right angle!

On another occasion, in my own house, I saw what I believe is a most unusual thing, that is, the fact of two succeeding discharges striking the same object. It was another very bad storm, and the sky was on this occasion quite green. The first flash struck the telephone, and I saw the light of the burning metal between the edges or chinks of the case. Almost instantly a second discharge struck it, blowing off the door and melting things up generally.

What I hope may make these remarks interesting to the "stay-at-homes" is the fact that in England one does not get opportunity of observing these intense effects, or at such frequent intervals as in South Africa, thus preventing them from studying these most interesting phenomena. For instance, it is intensely interesting to watch during a storm the discharges to earth through the Thomson magnetic blow-out arrester. I have fitted all the different patterns. I may say here that I do not believe that an arrester exists that will arrest at all times in our country, but the above are the best I know. You will see at times, for no apparent reason, that the flash and its consequent blow-out are instantaneous, too quick to follow; while at other times you may distinctly see the arc go up the horns until it breaks—blown out. Of course, on all occasions the dynamo current may not follow the lightning discharge, and be thus switched back again, as it were, but too many things happen at once on these occasions, and one cannot follow them all.

Another instructive object lesson I once appreciated. Some years ago there stood outside the Court House at Durban, Natal, a high flag-staff, with top mast. Steel wire ropes were carried down from the cross-trees to within 6 feet or 8 feet of the ground, where they were foolishly joined to the anchor plates by intervening rope lanyards. I saw the lightning strike this. Of course, it could only pass to earth over the wet ropes, and the result was an awful smash up.

Last, but not by any means least, I may add the following: I came home in 1889 principally to see the Paris Exhibition, and on my return voyage in November of that year, our vessel ran into the most awful storm it has been my fate to experience at sea. It commenced before we rounded Ushant, did its worst in the Bay, and followed us for eight days. At its height I saw then for the first, and I earnestly hope for the last time, luminous balls of fire on each masthead—St. Elmo's fire, so called. The marvelous grandeur, of such a storm one cannot dispute, in spite of physical discomfort; the inky blackness of water and sky, the white flying spindrift, the laboring vessel wallowing in the waves coming in hundreds of tons over her bows, in spite of her engines running only quarter speed, the howling hurricane and almost continuous lightning, and calmly sitting above all this disturbance these mystifying luminous spheres. Whatever they may be or how producea, it seems to me that the old seaman shaking his head at them is as

*From the "Electrical Review," London.

wise or as ignorant as the rest of us. On this occasion and others I should have revelled in the companionship of the crank who so constantly rams it down the throats of the reading public that no waves ever exceed 40 feet in height. I am inclined in my vanity to think that the gentleman in question has not made the acquaintance of a genuine cyclone.

A real No. 1 grade cyclone I had the pleasure of sampling blew down the registering anemometer after it had recorded a speed of some 90 miles per hour, thus leaving the calculation of its eventual speed to the imagination. It held the writer in the angle of a building as fast as if he had been nailed, while the neighboring trees and iron roofs "went by the board." The sea came up on the land, verandas, iron roofs and house fronts were swept away, and a warehouse belonging to a shipping firm collapsed like a house of cards—walls, roof, woodwork and contents in a heap. Most of the lightning display on this occasion occurred within the electric lighting station, which fed a lot of overhead mains, which were swept away lock, stock and barrel, while the engineer in charge endeavored to shut down engines and switch off circuits with feet as well as hands, and wished for the nonce he had been endowed like the centipede.

Another Electrical Invention.

A dispatch from Chicago says the "noiseless court," an electrical invention, was announced Saturday night at the banquet of the Northwestern Association of the Massachusetts Institute of Technology. The announcement was made by Prof. W. Elwell Goldsborough, of Purdue University, head of the electrical exhibit at the Louisiana Purchase Exposition.

The invention is the production of J. F. Hutchinson, an electrical engineer of New York, who has been in St. Louis for some time working out the details. The device is of such a nature that no sound is heard by a person standing within the court until an ordinary telephone receiver is placed to the ear. Then not only the sounds in the court become audible, but also conversations which may be going on over nearby telephone wires.

It is stated that by means of the "noiseless court" conversations between points hundreds of miles distant from each other will be made audible within the court.

The exact nature of the device is not revealed. The news of its success was received by Prof. Goldsborough less than an hour before the banquet.

An Energetic Sales Manager.

Mr. I. A. Bennett, general sales manager for the Electric Appliance Company, Chicago, has resigned his post which took effect March 1, and will open the Chicago offices of the Phelps Company of Detroit, Mich., manufacturers of the Hylo turndown lamps and other specialties. Mr. Bennett resigned a position that he held with the Electric Appliance Company for a considerable length of time, having served with this company for about eleven years, having previously been connected with the Ansonia Electric Company.

MR. I. A. BENNETT.

Mr. Bennett's energetic push as a sales manager and originality as an advertising man has made him one of the best known men in the electrical business, and he is receiving congratulations on all sides on his entrance into a field which promises very handsome returns. He has also accepted the presidency of the Central Station Publishing Company, which is being formed for the promotion of central station advertising.

His offices will be located in the Monadnock Building, Rooms 529 and 530. He will carry a full and complete stock of every style, base, and voltage, Hylo lamps and specialties, making shipments from Chicago stock.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEBRUARY 23, 1904.

Electric Railways and Appliances.

752,719. Automatic Signaling System for Electric Railways. Harry B. Snell, Cement City, Mich., assignor, by direct and mesne assignments, to the Snell Electric Signal Company. Filed July 17, 1903.

752,737. Trolley. Thomas F. Wetton, Newark, O., assignor of one-half to Charles E. Krebs, same place. Filed Oct. 27, 1903.

752,812. Electric Block-Signal System. Charles W. S. Turner, Mountville, Va. Filed April 3, 1903.

752,822. Alarm-Signal for Railway-Trains. Hugh E. Butler and Joab L. McCollum, Atlanta, Ga. Filed Nov. 12, 1903.

752,824. Electric Railway Switch. Harry H. Chandler, Waltham, Mass. Filed Oct. 24, 1903.

752,839. System of Electric Train-Lighting. David C. Henry, Denver, Col., assignor to Henry Electric Equipment Company, same place. Filed Sept. 23, 1901.

Electric Lights and Appliances.

752,865. Electric-Arc Lamp. Carl Schuster and Christian N. Bergmann, Pittsburg, Pa. Filed March 20, 1902. Renewed July 18, 1903.

753,134. Electrical Illuminating Device for Show-Windows. John H. Goebst, Chicago, Ill. Filed May 6, 1903.

753,138. Portable Electric-Lamp. Harry C. Hubbell, Brooklyn, N. Y., assignor to Horace W. Fuller, New York City. Filed July 2, 1903.

Electrical Machinery and Apparatus.

752,643. Electric Pump for Switching Mechanisms. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed July 31, 1903.

752,691. Inductor-Alternator. Leon J. Le Pontois, New Rochelle, N. Y. Filed Aug. 22, 1903.

752,692. Polyphase Magneto-Alternator. Leon J. Le Pontois, New Rochelle, N. Y. Filed Nov. 7, 1903.

752,820. Dynamo-Brush. Max Bunnig, Gardelegen, Germany. Filed Oct. 5, 1903.

752,858. Electromagnetic Switch Device for Apparatus for Magnetically Recording and Strengthening the Reproduction of Speech, etc. Peder O. Pedersen, Copenhagen, Denmark. Filed June 21, 1901.

752,953. Transmission-Gear. Alanson P. Brush, Detroit, Mich. Filed Oct. 11, 1902.

753,191-192-193-194. Electric Meter. Thomas Duncan, Chicago, Ill. Filed July 11 and 18, 1901; Oct. 23, 1903, and Jan. 2, 1904.

Telephones and Telephone Apparatus.

752,649. Telephone Attachment. George B. Buchanan, Haverstraw, N. Y. Filed Sept. 15, 1902.

752,710. Means for Synchronizing the Instruments of Telephone Systems. Hope Redmon, Rufus L. Hope and Robert H. Conway, Cynthinia, Ky. Filed Sept. 17, 1903.

752,722. Switchboard. Alfred Stromberg, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed May 13, 1902.

752,761. Multiple-Switchboard System. William M. Davis, Chicago, Ill., assignor, by mesne assignments to the Stromberg-Carlson Telephone Manufacturing Company. Filed Dec. 7, 1900.

752,909. Telephone Signaling Mechanism. Oscar O. Lee, Chicago, Ill. Filed Jan. 11, 1900.

753,067. Telephone or Telegraph System. Robert Hamton, Milton, Mass. Filed Feb. 10, 1903.

753,183. Telephone Selecting Device. William D. Watkins, San Jose, Cal., assignor to the Watkins Manufacturing Company, San Jose, Cal. Filed Aug. 29, 1902.

Miscellaneous.

752,652. Electrical Apparatus for Registering the Discharge of Liquids by Pumps. Hans J. S. Cassal, London, Eng., assignor to the Liquid (Electric) Register Sydicate, Limited, same place. Filed March 17, 1903.

752,689. Electrically Propelled Vehicle. Louis Krieger, Courbevoie, France. Filed Feb. 26, 1903.

752,696. Electric Cord Adjuster. Jonathan E. Masterson, Spokane, Wash. Filed May 23, 1903.

752,705-752,921. Audiphone-Receiver. Hermann G. Pape, Brooklyn, N. Y., assignor of thirty one-hundredths to James McVey, New York City. Filed Oct. 21, 1902, and Sept. 13, 1902.

752,834. Electrical Receptacle. Philip H. Fielding, New York City. Filed June 27, 1903.

752,840. Flexible Conducting-Cord. Howard B. Holmes, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Filed Jan. 27, 1902.

752,843. Signaling Apparatus. Robert B. Kernohan, Pittsburg, Pa. Filed May 23, 1903.

752,894. Selective Signaling. Reginald A. Fessenden, Fort Monroe Va., assignor by direct and mesne assignments, to the National Electric Signaling Company. Filed Dec. 29, 1902.

Removal Notice.

The Western Telephone Manufacturing Company has leased quarters in the Atlantic Building, 42 West Jackson Boulevard, Chicago, Ill., and will move its factory and office to this address March 5.

THE TELEPHONE WORLD.

Iowa Telephone Association.

The eighth annual meeting of the Iowa Telephone Association will convene in the "Ordinary" of the Savery House, Des Moines, on Tuesday, March 8, at 2 P.M., for a three days' session.

The following is an outline of the programme: President's Address; The Farm Line Proposition; Operating a Telephone Plant as a Side Line; Long Distance Lines; Jealousy Among Independent Telephone Men; Shall we Establish a Clearing House; Automatic Apparatus from the Standpoint of Service and Operating Expense; Our Business Relations; Leased Toll Lines; How Can We Promote Better Feeling Among Toll Operators, Inducing Harmony, Improving Car Service, and thus Reducing the Lost Call Record; Necessity of Uniformity in Toll Line Service and Rates; Our Loyalty to the Principles of the Association.

The Michigan State Telephone Company, the successor of the recently reorganized Michigan Telephone Company, announces the election of directors and officers as follows: Directors—W. C. McMillan, T. H. Newberry, John T. Shaw, Henry Russel, Frank J. Hecker, A. E. F. White, Elwood T. Hance, all of Detroit; Lewis H. Withey and Dudley E. Waters, Grand Rapids; N. W. Harris, W. A. Jackson and A. G. Farr, Chicago; Isaac Sprague and F. A. Farrar, Boston; Allen B. Forbes, New York. Officers—W. C. McMillan, chairman executive committee; W. A. Jackson, president; T. H. Newberry, vice-president; Elwood T. Hance, secretary; John T. Shaw, treasurer; N. W. Harris, chairman of board; L. C. Krauthoff, general counsel; Elliott G. Stevenson, attorney. The active management will be under the supervision of Mr. Jackson, president, and the executive committee of which Mr. McMillan is the chairman.

At a meeting of the citizens of the town of Boston, N. Y., for the purpose of organizing a telephone company to connect Boston and Hamburg, the following officers were elected: President, Fred Frank; vice-president, Philip D. Weber; secretary; Frank X. Weber; treasurer, Edward Heinrich; electrician and collector; Jacob Brodbek. The organization will be known as the Boston Valley Telephone Company. It expects to begin operation as soon as the frost is out of the ground.

The Central New York Telephone & Telegraph Company, embracing St. Lawrence, Jefferson, Hamilton, Lewis, Herkimer, Oneida, Madison, Onondaga, Chenango, Otsego and Delaware Counties, and the Empire State Telephone & Telegraph Company, embracing Oswego, Cayuga, Cortland, Seneca, Wayne, Ontario and Yates Counties, have united.

President Wheeler of the Illinois Tunnel Company is quoted from Chicago as saying that the company now has installad nearly 6,000 telephones in the down-town district and will have 10,000 in service by July 1.

The Southwestern Telegraph & Telephone Company is about to expend $80,000 in extending and improving its system in San Antonio, Tex.

New York Ahead of London in Telephones.

A dispatch from London says an interesting comparison of English and American telephone systems, made recently, shows London to be a long way behind New York.

In the latter city, an area of 429 square miles, with a population of 4,000,000, as against London's 640 square miles, with a population of 6,500,000, is covered with no less than 200,000 wires, while London, including the 15,000 post office lines, can only boast of 80,000.

Despite this big difference and the fact that London pays a proportionately heavier rate the service on this side leaves very much to be desired, and, as regards efficiency, it certainly is not to be compared with New York

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The Big Eddy Telephone Company was lately incorporated in Albany, N. Y., to operate in Orange and Sullivan Counties and in Pennsylvania: Its capital stock is $8,000, and directors: Frank Kinnie and G. W. Engleman of Narrowsburgh, and M. G. Noble of Calkins, Pa.

It is declared that the Syracuse, N. Y., Telephone Company is to branch out considerably. Joseph J. Jermyn of Scranton, Pa., president of the company, has recently been completing arrangements for a bond issue of $400,000 to practically reconstruct the company's system.

The Electric 'Phone Company of Stewart, Minn., has filed articles of incorporation with the Secretary of State. The capital is $25,000, and the incorporators are Henry E. Poseley, Edward N. Sckmidtz, Edward Reinhardt and A. Schmidtz.

The Maryland Telephone & Telegraph Company has succeeded in installing more than 1,000 new telephones since the fire, and of this number 800 have been given to old subscribers, who were forced into new places of business.

The Indian Territory Telephone Company, with headquarters in Vinita, has just completed a line from Tulsa to Muskogee. The line runs parallel to the Missouri, Kansas & Texas Railroad between the two towns.

The farming community east and north of Summitville, Ind., in Boone and Van Buren townships, is to have a new telephone system. Robert W. Inglis, of Summitville, having been granted a franchise by the county commissioners.

Articles of incorporation have been filed by the Phelps County, Neb., Telephone Company, which has a capital stock of $40,000. The incorporators are C. W. Stiger, C. C. Fansburg, J. F. Butterfield and F. W. Barber.

The Delaware & Atlantic Telephone Company has raised its rates at the Cape May County, N. J., seaside resorts.

The Farmers' Mutual Telephone Company of Tonkawa, Okla., has filed an increase of capital stock from $2,500 to $10,000.

The Central New York Telephone Company 's planning to make Syracuse instead of Utica its headquarters.

Constant Increase of Telephones.

At the convention of Independent telephone companies in the Ohio Valley, which convened in Cincinnati recently with over 100 exchanges represented, a paper was read by J. B. Hoge of Cleveland, on the "Independent Telephone Situation." He said in part:

"When the Bell patents expired nine years ago there were less than 300,000 telephones in operation, and now there are millions. Last year more than 1,000 Independent telephone companies were organized in the United States, or over two a day. In four years the Independent long-distance lines have grown as rapidly as exchanges.

"The farmer's life has been revolutionized, especially in little exchanges, giving them connection with the post office and county seats.

"The through business is handled the same as coupon tickets are sold over the railroad and freight is billed over various lines. There are to-day over 2,000,000 Independent telephones in operation in the United States, and 1,000,000 Bell telephones, and the business is yet in its infancy."

A. W. Carter of Grenada, Miss., who owns and operates a long-distance telephone line between that city and Eupora, has been in the latter place investigating the practicability of establishing an exchange there. The project met with much encouragement on the part of the business men and citizens and a considerable list of subscribers was soon secured. Application will be filed soon asking for a franchise, and this doubtless will be granted by the board of aldermen. The enterprise will be pushed to completion as soon thereafter as practicable.

It is understood upon good authority that the Hyden Telephone Company has now been organized and will soon begin the construction of a telephone line from Barboursville to Hyden, Ky. The men interested in this enterprise are R. M. Jackson, A. B. Eversole, Abner Asher, John Woodward and Judge H. C. Faulkner. Mr. Jackson will be treasurer and Mr. Woodward manager, but the president has not been decided upon. An exchange will be put in at Manchester and branch lines will be run out to various points in Clay and Leslie Counties.

Telephone Incorporations.

The Waldo Home Telephone Company, Waldo, O. Capital stock, $25,000. Incorporators: William Klingel, M. Lewis, A. Oborn, W. P. Kraner and Sam Schrader.

The Liberty Center Telephone Company, Liberty Center, Ind. Capital stock, $2,500. Incorporators: James P. Mounsey, Lewis A. Minniear, Orin D. Garrett, Joseph Stahl and George M. Gavin.

The Hamilton County Independent Telephone Company, Webster City, Ia. Capital stock, $24,000. Incorporators: D. C. Chase, J. W. Lee, Chris. Williams, Sam Sweedland and C. L. Poland.

The Pilot Mound Farmers' Mutual Telephone Company, Pilot Mound, Ia. Capital stock, $10,000. Incorporators: William Larson, O. W. Hinman, George O. Durrell, George Owen and L. A. Carlson.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Anadarko, Okla.—At at election held here recently $50,000 in bonds was voted for the construction of sewers and a municipal electric lighting plant.

Anniston, Ala.—A. H. Quinn and associates have asked for a franchise here to build and operate an electric light and power plant.

Beloit, Wis.—The city council has advertised for bids for a municipal electric light plant.

Cambridge, O.—The Cambridge Electric Light & Power Company was lately incorporated for $500,000 by R. V. Orme, O. H. Haber and W. Moss.

Carroll, Ia.—A. Brown has purchased J. W. Kennebeck's interest in the electric light and heating plant, and is now sole owner. Plans are being prepared for the improvement of the plant. Three new boilers, a new engine and a new dynamo are among the equipments so far decided upon.

Dover, Del.—W. H. Walker, mayor, states that this city will probably have to extend its electric plant within the next four months. The electric light and water committee has charge of asking for bids.

Frankfort, Kan.—The citizens are agitating the question of erecting an electric lighting plant.

Fort Branch, Ind.—As soon as the weather permits work will begin on the new electric lighting plant here.

Hannibal, Mo.—The city council will soon employ a constructing engineer to draw plans and specifications for the new electric light and power plant here.

Jasper, Ind.—This town proposes to purchase the electric light plant, and put in a power house of sufficient capacity to furnish the town and private business houses, etc.

Jefferson, Tex.—The city council has granted a new franchise for an electric and gas plant to a Chicago company.

Lena, Ill.—This town is agitating the question of erecting an electric light plant to cost about $10,000.

Maynard, Minn.—The citizens are agitating the question of building an electric light plant.

Montague, Mass.—The stockholders of the electric light company have voted to buy a storage battery.

Monticello, Wis.—E. L. Babler is interested in the proposed electric light plant.

Mooresville, Ind.—The Public Service Company, recently incorporated with $50,000 capital, will erect an electric light plant and waterworks here. W. B. Vestal and B. V. Hubbard are interested.

Mountain View, Mo.—Williams & Co. are contemplating putting in an electric light plant shortly.

North Vernon, Ind.—A movement has been started to enlarge the electric light plant here.

Ogden, Ia.—This town will receive sealed bids until March 15 for the construction and all the material necessary for an electric light plant. William Bakely, mayor.

Omro, Wis.—The Omro Electric Light Company has been incorporated with a capital of $10,000 by J. Challeny, J. S. Lighten and others.

Stoughton, Wis.—The citizens will soon vote on building a new municipal electric lighting plant.

Uvalde, Tex.—This city is to have electric lights. W. H. Rose, the owner and manager of the new gin here, is making arrangements to put in the plant at an early date.

Waterville, Kan.—An electric light plant is to be installed here.

Woonsocket, S. D.—A company composed of local business men has secured a 20-year franchise for an electric light and heating plant. The franchise requires work to be commenced April 15.

STREET RAILWAYS.

Asbury Park, N. J.—The Seacoast Traction Company has been formed to construct a trolley line to Sea Girt. connecting at Belmar with the Atlantic Coast line from here. The officers of the company are. President, Charles L. Spier of New York; vice-president, E. V. Patterson of Spring Lake; secretary, R. E. Rafferty, and treasurer, I. K. Harrison, both of New York.

Baraboo, Wis.—W. J. Bell, former manager of the Baraboo Telephone Company, is endeavoring to interest business men in an electric line to extend from here to Grand Rapids.

Bloomington, Ill.—There is a project on foot whereby the Reed Investment Company of Colorado Springs, Col., may take up the work of a new electric line from Peoria to this city. —W. H. Knight has secured the right of way for an electric line between here and Decatur.

Chippewa Falls, Wis.—The Chippewa Valley Electric Railway Company has decided to make a bond issue to extend its lines.

Denver, Col.—The Bear Lake Valley Railway & Electric Company was lately incorporated, capitalized at $100,000. H. E. Slusser and M. Smith are among the directors.

Durand, Mich.—The common council has granted a franchise to build and maintain an electric railway in this village to J. D. Leland.

Edmonton, Can.—The council has accepted the plans of W. G. Trethway, promoter, of Montreal, for an electric street railway.

Elwood City, Pa.—The Wayne Electric Street Railway Company will build a road from this city to Park Gate. Its capital stock is $6,000. H.S. Blatt is president.

Franklin, Pa.—Pittsburg capitalists, headed by J. W. Boileau and W. S. Ravenscroft, will build a new trolley line from here to Butler.

Hamilton, Ont.—The city clerk has received notice from Wallace & Little of Woodstock that they will apply for a Dominion charter for an electric railway to run from this city to Brantford.

Hillsboro, Ill.—The Hillsboro Electric Company has been incorporated with a capital of $15,000.

Kankakee, Ill.—The Kankakee Interurban Riverview Railway Company will present a petition to the president and board of trustees of the village of Waldron for the consent to construct, operate and maintain an electric street railway.

Lexington, Ky.—The Blue Grass Traction, which operates a line from here to Paris, Ky., and the Lexington & Georgetown Traction, which operates a line from this city to Georgetown, have been consolidated with Yunger Alexander as president. A. S. Rice, vice-president of the Equitable National Bank, is to be the treasurer and secretary. The capital stock will be $750,000. The stock in both companies is owned practically by the same men.

Louisville, Ky.—The line of the Kentucky Traction Company is to be built from this city to Nashville at once.

Macungie, Pa.—The Allentown & Reading trolley line will be extended to this place.

Minneapolis, Minn.—The Minnesota Power & Trolley Company is the name of the new company which proposes to build new electric railroads. It is said one will run from here to Stillwater.

Mount Holly, N. J.—The Burlington County Trolley Company is considering the propriety of extending its road from this place to Pemberton by way of Smithville.

Ottawa, Ill.—The McKinley Syndicate may build electric roads in Cuba.

Philadelphia, Pa.—The Wilkins & Braddock Electric Street Railway Company has been incorporated with a capital of $21,000. H. McKinney is president.

Sacramento, Cal.—Israel Meyers is the promoter of the Sacramento, New Castle & Oroville electric road.

Wabash, Ind.—The Wabash & Rochester Railway Company is going to introduce the Pullen or wireless system in the construction of its road in Indiana. All overhead wires are abolished and the cars are impelled by a system of magnets. The roadbed is provided with a series of specially constructed tubular armatures. adapted to be energized by magnets upon the car, by which they will close automatically for a period corresponding to the time the car is over them.

Waterloo, Ind.—F. E. Seagraves is the promoter of the Toledo & Western electric line, which is being surveyed through this place.

POWER PLANTS.

Anniston, Ala.—The Coosa Water Power Development Company, capitalized at $250,000, has purchased the land and water right in Calhoun County at Lock 3, and proposes to harness the abandoned portion of the Coosa River there and utilize it as power. The right to build a dam has been granted by the Secretary of War and the company will build the dam this summer. The company proposes to erect a power plant and lay off a number of manufacing sites.

Fremont, Neb.—The Fremont Power & Canal Company will develop a 3,500 hp. plant on the Platte River, and will furnish electric power for Omaha, Lincoln, Council Bluffs, Columbus and this city.

BIDS WANTED.

Washington, D. C.—The Treasury Department is inviting sealed proposals until March 28 for manufanturing and placing in position in complete working order in the United States Custom House at San Francisco, Cal., combination gas and electric light fixtures. Drawings, specifications and blank forms of proposal can be obtained upon application to the Secretary of the Treasury, this city.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅜@12½c.; Lake 12½@12⅝c.; casting, 12¼@12⅜c.

The St. Paul (Minn.) Electric Company has increased its capital stock to $100,000.

It is admitted that a new issue of General Electric stock has been discussed by the officials.

The Otis Elevator Company will hold its annual meeting in Jersey City Monday, March 21.

It is said that the plans for reorganizing the Eastern Ohio Traction Company are well under way.

The official announcement is made that the Bell Telephone Company of Montreal will soon issue $2,000,000 of new stock.

R. R. Govin, who represents Eastern interests in the Chicago Union Traction Company, has resigned as receiver of the company.

Plans have been made public by which the Brooklyn and Williamsburg bridges in this city will be connected by an elevated road.

The Keystone Telephone Company of Philadelphia hereafter will not issue monthly statements of earnings; the income account will be made public quarterly.

Reorganization of the Chicago Union Traction Company is about to be undertaken by majority interests, largely represented in New York and Philadelphia.

The Richmond (N. Y.) Light & Railroad Company reports for the quarter ended December 31, a surplus after fixed charges of $2,636, a decrease of $1,735.

The South Side Elevated Railroad Company of Chicago has declared the regular quarterly dividend of 1 per cent., payable March 31. Books close March 21 and reopen April 1.

The annual report of the National Carbon Company for the year ending January 31, 1904, showed net earnings of $736,441, compared with $594,372 the previous year. The increase was $142,069, or about 24 per cent.

It is reported that part of the funds derived from the million dollar mortgage authorized by the stockholders of the Philadelphia & West Chester Traction Company will ultimately be used for the purpose of double-tracking the road.

The Underground Electric Railway Company has awarded to the British Thomson-Houston Company, Ltd., of London, the contract for $7,000,000 worth of motor equipment for cars to be used on the underground and surface systems of London.

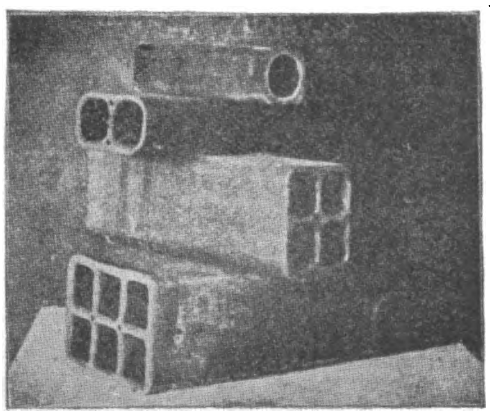
The Edison Electric Illuminating Company of Savannah, Ga., has called for redemption on or before April 1, of $500,000 mortgage bonds dated April 1, 1899, at par and 5 per cent. premium. The bonds will be redeemed at the American Loan & Trust Company, Boston.

It is said that the Metropolitan Street Railway Company of New York will not seek the credit of the city in the financing of its proposed subway. The estimated cost of construction of the new underground route is $40,000,000 as compared with $35,000,000 for the so-called Belmont subway.

The continued rise in price of the Fairhaven and Westville trolley road stock of New Haven, Conn., has brought out the fact that a determined bid is being made for control of the property by the Consolidated road. The trolley road occupies all of the street railroad field in New Haven, West Haven, East Haven, Cheshire, Branford and Milford, and is one of the best paying properties in Connecticut.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Feb. 29
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	141½
Metropolitan Street Railway	114½
Metropolitan Securities	84
Ninth Avenue	200
Third Avenue	120½
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	235
Brooklyn Rapid Transit	40⅜
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	64
Philadelphia Traction	97¼
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	140
West End Street, com	90½
do. do. do. pref	109
Chicago.	
City Railway	165
North Chicago	87
Union Traction, com	5½
do. do. pref	31½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	21
do. do. pref	46
Electric Lead Reduction	⅞
Electric Vehicle, com	9
do. do. pref	13
Westinghouse, com	158
do. pref	194
General Electric	160
Boston.	
Edison Electric Illuminating	235
General Electric	160
Massachusetts Electric Companies, com	21
do. do. do. pref	78
Westinghouse Electric & Mfg., com	79
do. do. do. pref	90
Chicago.	
Chicago Edison	152½
National Carbon, com	25
do. do. pref	94
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	55
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	121
Western Telephone Company	11
New England Telephone Company	120
New York.	
American Telegraph & Cable Company	84¾
Commercial Cable Company	192
Mexican Telephone Company	2
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	87¾
Miscellaneous.	
Chicago Telephone Company	120
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	33
Consolidated Car Heating	64
Standard Underground Cable	200



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CONTENTS.

EDITORIAL NOTES.

Another Decision in favor of Weston Patents

In the issue of ELECTRICITY of December 10, 1902, referring to a decision of Judge Coxe, in the United States Circuit Court for the Southern District of New York, in favor of the Weston Electrical Instrument Company versus the Keystone Electrical Instrument Company for infringement, we warned not only dealers but users of electrical measuring instruments as well to make sure before handling a given make of instruments that they were not laying themselves open to trouble and annoyance through lawsuits.

We refer to this matter at this time because Judge Wheeler of the same court has just rendered decision in another suit brought by the Weston Electrical Instrument Company of Newark against the Jewell Electrical Company of Chicago and others, upholding the validity of the patent granted to Mr. Edward Weston for instruments for measuring electrical quantities on direct current circuits. The inventions covered by the patent in question have created the practical art of electrical measurements and have unquestionably been of incalculable value to electrical engineers, scientists and all users of electricity throughout the civilized world. Moreover, these inventions of Mr. Weston's have contributed very largely to the immense advance in the industrial applications of electricity that have been made in the last fifteen years, not only in the United States but in every European country as well.

The Weston Electrical Instrument Company proposes to guard its rights and interest, and with that object in view a number of similar suits are pending against various concerns and individuals.

A New Block Signaling System.

Inventors are apparently at work in all parts of the country devising systems for preventing railway accidents. We have from time to time referred to some of these in ELECTRICITY, and we now propose to describe another, recently brought out by a resident of Warwick, R. I.

This system is intended for use in interurban trolley railways.

The signals are actuated automatically by passing cars to indicate the presence or absence of other cars in the blocks.

The signaling system is particularly adapted for use on a single-track road with turnouts, each section of single track constituting what is known as a block. Each end of each section is provided with a signaling apparatus, both of which are moved at the same time to set the signals when a car enters an empty block and to restore the signals to normal conditions when the last car leaves the block. When a car enters the trolley wheel comes in contact with and operates a switch lever, which is thrown to the contact button by the passing trolley and through the wire acts on the signal to energize a magnet and cause a mercury switch bar to rise and break the electric connection, de-energizing another magnet, and allowing the target to fall to the danger position. As this target falls it also allows the switch bar to fall and connect the mercury wells, causing the current to pass through the line and light the cautionary signal, which is an incandescent lamp showing a green light either day or night at the entering end of the block, thus notifying the entering car that the danger signal at the opposite end of the block has been set. The customary signal can only be set when the danger signal at the opposite end of the block is in its proper position. When more

then one car enters the block from the same direction the magnet is energized and through the mechanism described turns back a finger a step each time a car enters the block after the signals have been set, and this finger is returned again a step toward its normal position each time a car leaves the block, until but a single car remains on the block. When the last car passes out of the block and the switch lever is thrown to the contact point a magnet is energized through the conducting wire and through the mechanism described causes the switchbar to descend and make a connection through the mercury cups thus energizing another magnet, raising the target out of the danger position, clearing the signals, and at the same time disconnecting the mercury switch, breaking the circuit and extinguishing the light of the cautionary signal.

The train in entering the block from the opposite direction operates on the signals the same as those approaching from the other direction. The lever being thrown over against the contact point acts on signal at the opposite end of the block, energizing a magnet and through the machanism throws out of contact the mercury switch, de-energizing a magnet and allowing the target to fall to the danger position. The target in falling to this position allows the mercury switch cup to make a contact and light the cautionary signal. The train in leaving this block throws the lever to the contact point, which through a wire energizes a magnet and through the magnet-operated mechanism makes the contact through the switch, energizing a magnet to raise the target and clear the danger signal. At the same time it disconnects the switch and extinguishes the cautionary signal at the opposite end of the block.

The current by which the signal mechanism is operated is taken from the trolley wire. After the current has passed through its circuit and performed its work it is conducted through wire to the ground, and where it passes through the lamps it is arranged to pass out through a resistance coil to the ground.

In the operation of the system as described the signal at the distant end of the block is set first and the signal at the entering end is set only after the signal at the distant end is in position. The signal at the entering end thus affords an indication that the system is in order and that the signal at the distant end has been set to prevent the entrance of a car to the block from the opposite direction.

If the wiring should break or the apparatus get out of order the danger signal will be set automatically. Should this danger-indicating target for any reason fail to fall to the danger position, then the cautionary signal at the entering end of the block will not be set. When the cautionary signal is not set it indicates to an approaching car that the signaling device is out of order or that there is danger ahead.

* * *

World's Production of Coal.

"Carrying coals to Newcastle" is no longer the piece of folly it once was deemed. Several years have now elapsed since a prominent American coal company delivered its first ton of coal at that famous English mart, and every year since then has added to the supremacy of the United States as the first coal producing country of the world. Great Britain, so long the chief coal source of the world, now takes second place in the roster of nations. In 1902, the United States exceeded its former rival by no less than 47,000,000 short tons. Even if the production of Canada, India, New South Wales, and all her other dependencies is added to that of Great Britain, the United States is still 20,715,451 short tons, or nearly 8 per cent. in the lead. It is now producing a little more than one-third of the entire coal supply of the world, or 301,582,348 short tons, and Great Britain's production amounted to 254,346,447 short tons, Germany's to 165,826,496 short tons. The other nations of the world brought the total production up to 884,795,343 short tons. No one, however, had any considerable production as compared with the three leaders, the United States, Great Britain and Germany.

The report of Mr. Edward W. Parker of the Geological Survey on the production of coal in 1902, which is now in press, contains a statement of the production of each country for each year for which the figures are obtainable since 1868. At the beginning of that period the United States held third place among the coal-producing countries, with an output but little more than one-fourth that of Great Britain, and 15 per cent. less than that of Germany. Twelve years later, in 1880, the production of the United States had increased until it amounted to nearly one-half that of Great Britain, and exceeded that of Germany by nearly 20 per cent. At the close of the next decade the production of the United States had increased to such an extent that Great Britain's output was only 1.4 times as much as ours, which was, in turn, about 60 per cent. more than Germany's. In 1899 the production of coal in the United States exceeded that of Great Britain for the first time in our history, the tonnage for the two being respectively, 253,741,192 short tons and 246,506,155 short tons. Each year since then the United States has increased her lead over Great Britain, until in 1902 our production exceeded that of Great Britain by more than 20 per cent. and that of Germany by more than 80 per cent. In the 35 years from 1868 to 1902, inclusive, the United States' production has increased 852 per cent., while that of Great Britain has increased 120 per cent.

The foregoing figures are interesting especially to large users of coal, such as managers of electric light and other power plants.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The Navy Department continues to receive encouraging reports of wireless telegraphic achievements at sea. The other day the Minneapolis at Guantanamo made connections with the Yankee, eighty miles away.

The most powerful automobile in the world has just been turned out in France for M. Bellemy, of Paris. It is equipped with an engine of 165 hp., and is geared to a regular speed of 80 miles an hour.

Rhode Island's House of Representatives indefinitely postponed a bill requiring the licensing of stationary engineers.

Mr. George H. Winstanley gave an interesting address before the members of the Manchester (Eng.) Geological and Mining Society recently, in which, says the *Electrical Engineer*, London, he spoke in favor of electricity as being an ideal form of energy for mining purposes. He concluded that the application of electricity on proper lines was no more dangerous than the application of energy in any other form. As a rule the plant was not so costly as compressed air, and the cables were much more convenient to install than air-pipes.

A dispatch from Vienna says the statement is made that Rockefeller's agents are trying to buy up the "Saxon Edelstollen Society" in Joachimthal, which controls the entire radium output of Austria according to an old contract. This contract is now immensely valuable and American financiers, it is claimed, have long been after it.

It is understood that the taking of stock by the General Electric Company has been completed, and the annual report of

the company is now being prepared. It will probably be ready for distribution within two or three weeks.

Electricity as an agency for thawing out frozen water mains is to be tried by the authorities of Hempstead, N. Y.

Announcement was made on Saturday that the Allis-Chalmers Company has entered into an arrangement with the Bullock Electric Manufacturing Company whereby the business of the latter will be taken over and the business of both companies carried on as that of a single interest. The business of the Bullock Company will be conducted, as heretofore, by its present management, under the form of a new Bullock Electric Manufacturing Company, organized under the laws of the State of Ohio, with George Bullock as president and Joseph S. Neave as vice-president. This combination will give the Allis-Chalmers Company the facilities of an electric plant.

Members of the plan and scope committee of the Rapid Transit Commission of this city have announced that it has been decided to hold a public hearing on March 10 on the proposition of the Metropolitan and Belmont interests to build subway extensions on the east and west sides.

In a two-and-a-half-mile race between a Missouri Pacific express train and an electric car on the Leavenworth-Kansas City Line last Thursday night the railroad locomotive was beaten by two car lengths. The roads are parallel and the electric line manager waited with a party of road officials at the beginning of the stretch. The railway engineer put on all steam, and the cars ran even until the last quarter of a mile, when the electric car slowly forged ahead and bounded across the finish line at fifty miles an hour, winner by 120 feet.

A meeting of the executive committee of the New York State Street Railway Association was recently held in Utica for the preparation of the programme for the next annual convention which will be held in that city on September 13 and 14. On the second day of the convention there is to be a question box in charge of W. W. Probasco. Special attention will be paid at the next convention to the exhibits by the supply men. The number of papers on the programme will be lessened this year, as past experience has shown that with a good many papers it is impossible to get through the programme on time.

THAWING OUT FROZEN WATER PIPES ELECTRICALLY.

BY WALTER M. PETTY.

The extreme severity of this winter has caused more frozen water pipes than were ever known before, and in the suburban cities a great amount of inconvenience and even suffering has been caused by this state of affairs. The plumbers seem unable to cope with the problem, orders coming in faster than they can be filled, by the cumbersome methods of excavating the streets and heating up the pipes by steam and fires.

View of Portable Thawing Apparatus.

In some instances the frost has been found in the ground at a depth of 5 feet. In the neighborhood of New York this is considered as extraordinary. As few service pipes are buried at a depth of more than 4 feet there is small wonder at the great number frozen up.

The plumbers being unable to solve the problem of relieving the suffering householder it seems but natural that electricity, the great "cure all," should step into the breach and once more prove its usefulness to mankind.

To Mr. Walter P. Schwabe, superintendent of the Gas & Electric Company of Bergen County, at Rutherford, N. J., should be given the credit of first employing on an extensive scale the heating effect of the current for the purpose of thawing out these frozen pipes. He employs two 10 kw. transformers connected in multiple, and stepping down from about 2,400 volts to about 50 volts. A water rheostat is used to control the primary current and an ammeter is also in the primary circuit. The whole outfit is mounted on a delivery wagon drawn by one horse, and three men are employed doing the necessary work. All the wires being overhead, it is a simple matter to connect the primaries of the transformers to the commercial lines by sending a man up the nearest pole. Heavy leads of No. 0 cable are then attached, one to the service pipe requiring thawing and the other to the service in a neighboring cellar. The circuit through the primary is then closed by means of the water rheostat, and in about one minute a perceptible heating is noticed in the pipes. This increases until the water flows. Ten minutes is about the average time required to bring the water. Sometimes it flows in about three minutes and at others it requires as many as twenty.

The average length of services may be taken as about 50 feet. Bridge measurements show a resistance between houses of .15 ohms. This is for lead pipe, of which a large majority are composed. Whenever an iron service is encountered

the effect of the increased impedence is felt. The rusty joints undoubtedly add to this resistance.

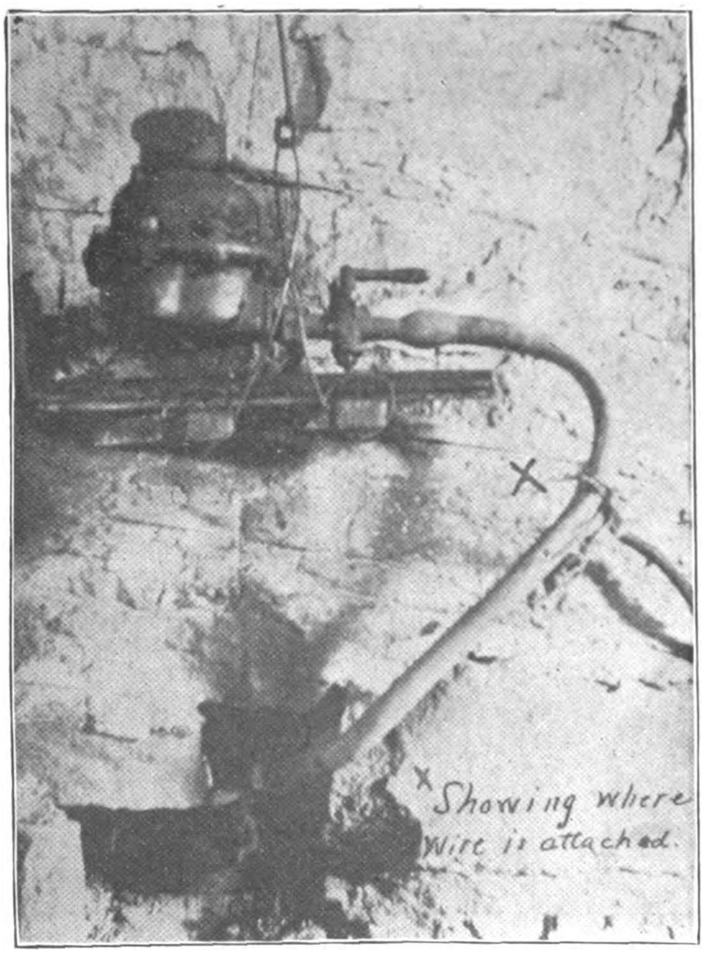
The average current in the primary circuit has been 9½ amperes, corresponding to about 360 in the secondary. In the case of iron services 5½ amperes in the primary have caused the water to flow, but the time necessary is increased. In round figures it may be said it requires about 20 kw. to do an average job.

Whenever two houses in the immediate neighborhood require thawing they can both be done at the same time.

One gang of men has done as many as 28 houses in one day, the average charge being about $8 per house, and the cost of the outfit not being more than $8 per day, this business is certainly a good paying one for the electrical supply companies.

One of the peculiar facts noted by the writer was that whenever it took longer than usual to thaw out a pipe, the first flow of water brings with it a quantity of sand and sediment which must act as a plug.

In taking bridge measurements in order to ascertain the resistances, the writer found at times he was unable to get a balance. Upon testing with a low reading voltmeter it was found that there existed a difference of potential of two-fifteenths of a volt between adjacent houses. There being no trolley line in the neighborhood it cannot be caused by leakage from the trolley circuits. Possibly the fact that the street mains are of iron and the services of lead may account for this flow of current. Time did not permit more extended observations, but they will be made in the near future.



Pipe Being Thawed Out.

LIGHTNING PROTECTION.

BY RALPH SCOTT.

Wherever the wires of any electric circuit are exposed to the weather, or what is more definite, where there is a possibility of a lightning discharge passing over them, the necessity arises of providing some means hy which such a discharge may be safely conducted to the ground.

Before taking up such means, it will not be out of place to consider a few of the principles involved. A discharge of lightning follows the same general laws as the current from an alternator, although there are several conditions which have greater import in static electricity than the simple alternating current.

Suppose we coil a wire to the shape shown in Fig. 1. If now we pass a steady current through this coil, there will be but very little self-induction. If there is passed through it an alternating current of say 120 alternations per second, the effect of self-induction will be very much greater. Practically, however, the effect even in this latter case will be very slight, and need not be considered. Of course, this self-induction (or opposition to any change in current strength) is greater in the coiled wire than in a straight wire.

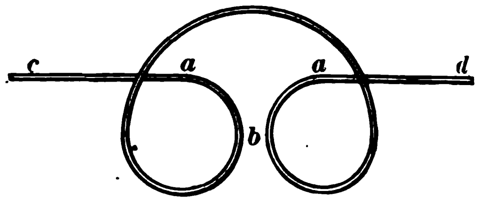


FIG. 1.

Suppose, now, a discharge of lightning pass from c to d. The self-induction of this coil will then be enormous. The reason for this is the fact that a discharge of lightning is not a rush of current in one direction only, but a succession of oscillatory discharges which pass back and forth perhaps thousands of times in the short duration of a spark which is but the ten-thousandth part of a second. As the self-induction which we have in this case would have but little effect upon a current which changes in value very slowly, yet in a current which changes likes a lightning discharge, the effect increases enormously, since the self-induction, other things being constant, is directly proportional to the frequency of the current. In passing from c to d, therefore, the discharge will create a high difference of potential between the points a and a and would doubtless jump across the air-gap at b, rather than pass around the rest of the loop.

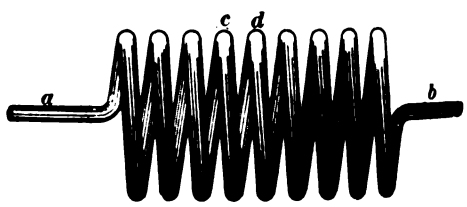


FIG. 2.

If we consider the solenoid, shown in Fig. 2, it is evident that the discharge would jump across the air-gap separating the respective turns, as from c to d, rather than pass through the coil. It is in this manner that street railway feeders are usually coiled when they pass the bus bars of the switch or distributing board to prevent the possibility of a discharge passing through the generators.

In the spark coil, shown in Fig. 3, which has an iron core, it would be impossible for a lightning discharge to circulate around the coil, but it would jump from one of the terminals AB of the coil

to the other; this action protecting the coil itself from injury, but introducing a fire hazard. If a wire connected to the ground was to be placed between these terminals, the lightning would escape to ground without dangerous consequences.

The above shows the protection from lightning which is assured to any highly inductive circuit if means are provided to allow the discharge thus impeded to escape to the ground.

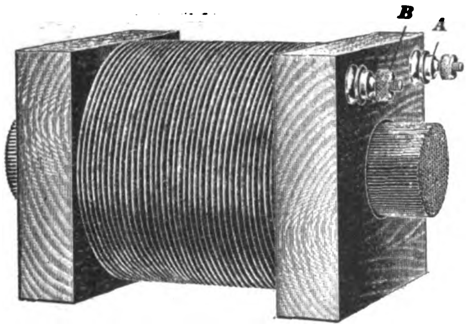


FIG. 3.

Lightning itself may be said to possess but few destructive tendencies from a thermal point of view. It is seldom that it alone causes the destruction of any inductive device. In the case of a non-inductive fine wire, the wire will be burned up, but it is of rare occurrence where a wire of a number greater than 20 is thus destroyed. When, however, the discharge jumps from one conductor to another, across which a difference of potential is maintained by some electric source, the arc forms a low resistance path across these points, across which the dynamo or other current passes. When such a current starts, if the distance be not too great, it is usually very nearly a short circuit, the heavy current thus passing acting destructively. Take, for instance, the armature of a

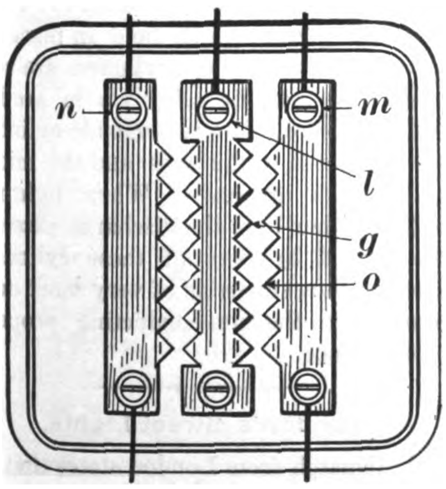


FIG. 4.

dynamo. When lightning passes through this armature, the discharge possibly leaps from two or more points in the armature conductors to the core, after which the inertia of the revolving parts completes the destruction by continuing the short circuit.

Before taking up the subject of the protection of generating or translating devices, the protection of telephones, signals, and telegraph instruments will be considered.

It is a well-known principle that lightning will more readily escape from a point, to a plate, or other points, than from a plate to a plate. This is due to a convection or silent discharge that takes place, and also because a greater amount of material is converted into a conducting gas when the discharge leaps from a point, owing to the minimum cooling material which exists at this point. This renders a much lower resistance path than would otherwise be the case.

In Fig. 4 is shown a simple form of saw-tooth arrester which utilizes this principle. Three metal strips or plates are provided as shown, having points g, o,

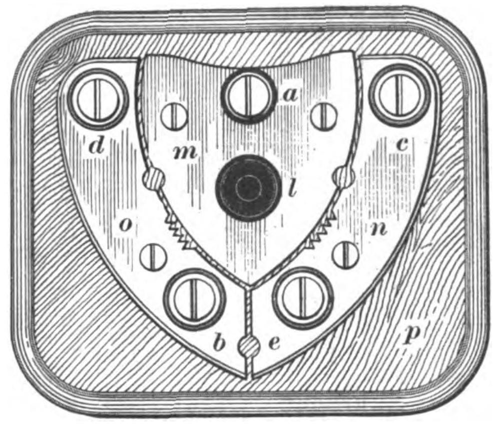


FIG. 5.

etc., resembling saw teeth. The central plate is connected to ground by the binding post l. The other two plates are in series with the line wires which are connected to the binding posts m and n. When the lightning discharge comes over either wire, it passes from the point to ground instead of going through the instrument. This type of arrester answers admirably for conducting a charge (induced in a line by proximity with a heavily charged cloud) silently to ground. As the sparks leap from one point on the line side to another on the ground plate, the ground thus established is not maintained because the difference of potential used is not sufficient to keep up the arc after the lightning spark has ceased.

In Fig. 5 is shown a type of lightning arrester which has been applied to both telephone and telegraph circuits quite extensively. Upon a wooden base, p, the metal plates, o, m, and n are secured.

Binding posts, d and c are connected to the line wires, while a is connected to ground. The instrument to be protected is connected to the binding posts, b and e. The discharge either leaps from the points to the plate m or jumps across the intervening space. A plug, l, may be inserted in the aperture shown so that it will connect either plate to ground to the lines in series. In practice this arrangement has proved itself both economical and efficient.

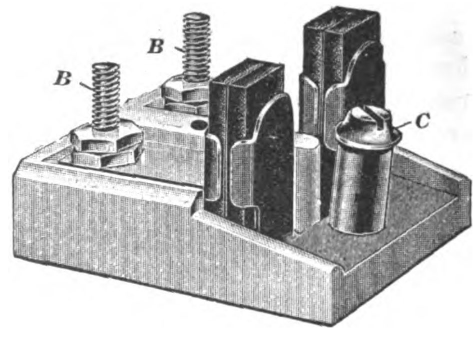


FIG. 6.

Another extensively used arrester is that illustrated in Fig 6. Upon a suitable porcelain base are mounted the binding screws B, these being connected to the lines. These binding screws are also connected by flexible means to small carbon blocks which are separated from other similar blocks connected to ground at c by means of paper or mica strips. A discharge will readily puncture this insulation and escape to ground, leaving the instrument uninjured.

In Fig. 7 is shown a standard form of combination arrester and sneak current protector. The line wires are connected to the screws, B—a small fuse carried on a holder and forced into contact with brass clips, which latter are connected to the lines and to the carbon blocks respec-

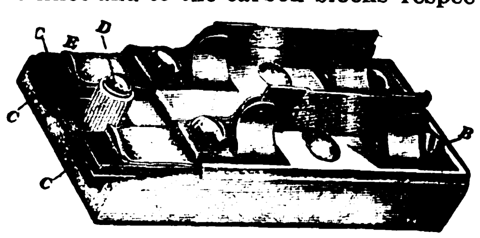


FIG. 7.

tively. The blocks, c, are insulated by mica, as stated before, and are held in place between the ground plate and the springy clips, E.

A special form of arrester which is applied to railroad signal circuits is shown in Fig. 8. Upon a porcelain form, F, the coil, H, is wound, consisting of a number of turns of bare iron wire. Above this coil is a brass strip, G, which is connected by the binding post, B, to ground. A is connected to the line wire, and D to the relay. Between C and D is a fuse. Lightning coming to A will jump to G

before it has circulated around many turns of H. Sometimes as many as 30 such arresters are arranged side by side. At E

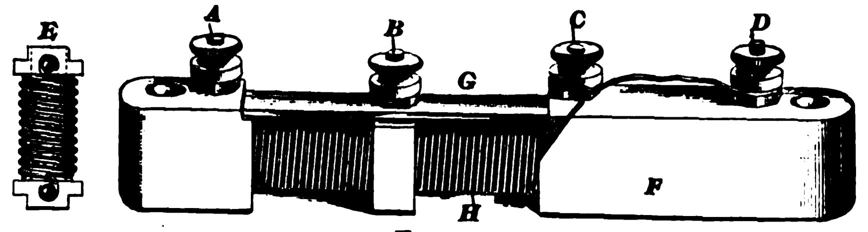


Fig. 8.

s shown a reduced drawing of another form of signal arrester. These are arranged in banks as shown in the illustration.

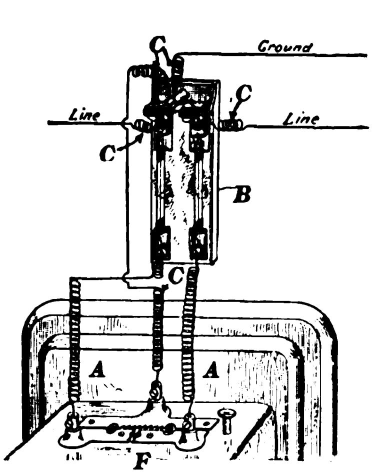


Fig. 9.

In connecting up lightning arresters, great care should be taken that no solenoids, kinks or bends occur in the ground wire, although the usual practice is to

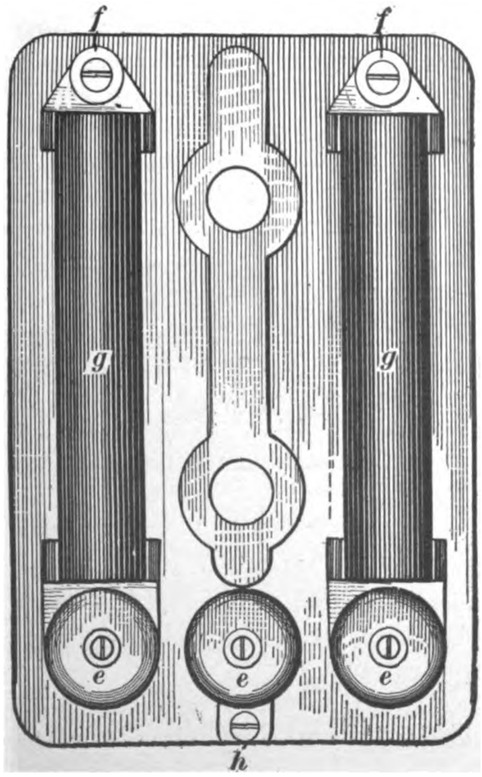


Fig. 10.

form the ground wire into fancy coils after it leaves the arrester. This is a poor scheme, since it tends to bring about a dangerous condition.

In Fig. 9, which represents a common way of connecting a telephone to the lines, the coils, C, should not be permitted, as this arrangement causes the lightning to seek another path rather than that direct to ground. On the other hand, the coils, A, insure greater protection for the instrument since they impede any charge which tends to pass through the instrument rather than pass directly to ground.

In Fig. 10 a form of arrester which is applied to high tension alternating circuits is shown. Upon a porcelain base, the non-inductive, non-metallic rods g are

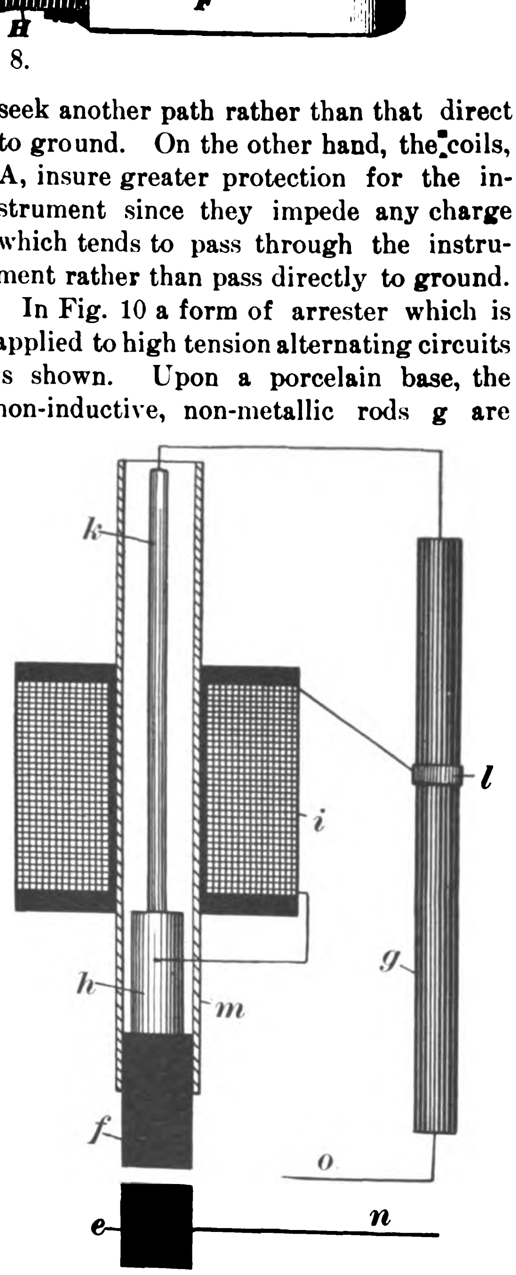


Fig. 11.

mounted. These have a high specific resistance; so high, indeed, that, when the full difference of potential of the circuit is across these resistances, they allow but a small current to flow. This does not effect the lightning discharge, however, as, being in the form of rods, they are practically non-inductive. Connected to these are two metal cylinders e e. The central cylinder is connected to ground by the connector h. The line wires are connected to f. If a discharge jumps from one of the outside cylinders to the grounded cylinder, a current from the line (if the circuit is grounded) escapes also. But this current is so small that upon the cessation of the discharge it ceases.

In Fig. 11 is given a diagram representing the connections and principles of the Garton arrester. Wire o is connected to the line, generally a railway feeder. The graphite rod g has a contact ring l to which one end of the coil i is connected. The current is wound on a non-metallic tube m within which is a freely sliding iron core h. To the latter are fastened

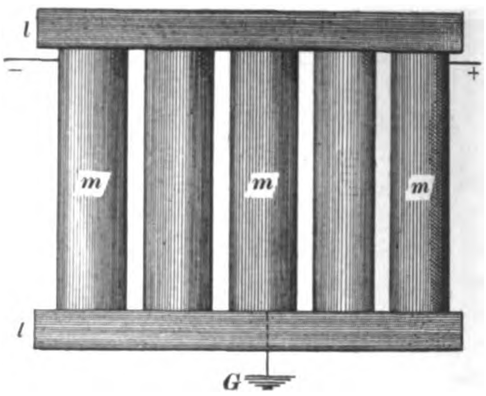


Fig. 12.

carbon pieces f, which carry the arc, and also the rod k. The carbon piece e is connected to ground by the wire n. When a discharge comes along o, it will pass through g, k, and f, across the air-gap to ground. Since this is a grounded railway circuit, the current follows the arc, the coil being shunted by part of the resistance, the current passes through it, thus lifting up h, which action combined with field set up by i disrupts the arc. When the arc is broken the carbon f returns to its normal position. It is noticed that in this arrangement the lightning does not pass through the coil i. This is necessary since i has a large amount of self-induction.

The principle of one form of Westinghouse arrester is shown in Fig. 12; l l are porcelain pieces which hold in place the cylinders m m. These cylinders are composed of a metallic alloy whose arc is a non-conductor. The two outside cylinders are connected to the lines and the middle cylinder to ground. When lightning strikes either line, the discharge passes to the ground by way of these cylinders. The arc thus started is of very short duration, due to the non-conducting property of the vapor.

London's Street Lights.

A dispatch from London states that the most recent returns show that the streets of the 118½ square miles of that city are lighted by 4,974 electric arc lights, 1,185 electric incandescent lights, 56,690 incandescent gas lamps and 18,248 flat flame gas burners.

DASH POTS FOR CORLISS ENGINES.

ARTICLE II.

BY W. H. WAKEMAN.

As a heavy dead weight dash pot is decidedly objectionable, it becomes necessary to devise one that will be light when it is time to start it into action, and heavy when weight is required to close the valve quickly. This seems almost like an impossible feat when first considered, yet it is accomplished with great precision in the modern dash pot, one of which is illustrated in Fig. 3. I do not mean to say that the weight of iron is transferred back and forth, to give the above mentioned result, but by an ingenious application of natural laws the desired result is secured.

The upper part of this dash pot 2 is

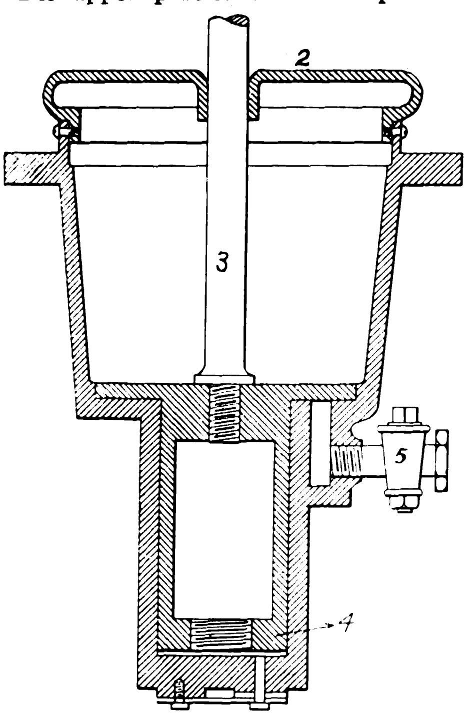


FIG. 3.

stationary as it forms a guide for the rod 3 which is fastened into the hollow plunger 4. The object in making this hollow is to have it as light as possible. When this plunger is raised by the valve gear above, air rushes in through the plug cock 5 and fills the large space below the upper part of plunger. When the valve is released this part of the dash pot offers practically no resistance to the descent because it is in equilibrium, but as it nears its present position, air is trapped underneath it, forming a cushion which prevents pounding. In order to prevent excessive cushioning, some air is allowed to pass out through the plug cock 5 which is adjusted to give the right amount.

It will be noted that there is a small chamber under the hollow plunger 4. When the plunger is raised this chamber is enlarged, and, as there is no way for admitting air into it, a partial vacuum is formed here.

Inasmuch as some men in charge of plants have mistaken ideas on the subject of a vacuum, and others appear to have not given the matter attention, a few remarks along this line are in order. A complete vacuum is a space from which everything has been removed. While this may seem to be a simple matter, it is more complicated than it appears. For illustration take the dash pot under consideration. The small chamber under the hollow plunger contains air, and as the plunger is raised this air expands until the whole chamber is filled with it, although it may be made twenty times as large as it now is. When this plunger is at its highest point, the chamber is still full of air, just as full as it is now, but the pressure is reduced according to the increase in volume. It is understood that no more air is admitted.

When the air pressure is reduced in this way, a partial vacuum is said to exist in the space below the plunger, therefore it is called a vacuum chamber.

The production of a partial vacuum does not create power or pressure, but it removes resistance, therefore it allows the pressure already existing to perform work or produce power. Let us note the possible result in this case. As the plunger stands in the cut, air pressure is equal all over it. When it rises, the pressure under it is reduced. Suppose that the air pressure on top of it is 14 pounds to the square inch, and when at its highest point the air pressure under it is reduced to 4 pounds. The mean effective pressure acting on the top of it to force it downward is 10 pounds per square inch.

If the plunger is 4 inches in diameter, its area is 12.5 square inches, therefore the total pressure forcing it downward is $12.5 \times 10 = 125$ pounds. To this may be added the weight of plunger and rod, from which must be subtracted the friction. If we assume that weight balances friction in this case, then the total effective force is 125 pounds, so that the reason for its rapid descent is plain.

Attention is called to the fact that the rod is rigidly attached to the plunger, with a guide above it. As the valve crank swings through part of a circle, there must be a joint somewhere in this rod above our point of view.

Fig. 4 illustrates another kind of dash pot, differing in detail from the previous illustration. The rod is attached to a solid plunger, which is now in its highest position. Air is prevented from entering the vacuum chamber 2 by packing rings 3 which are similar to those used in some steam pistons. Air pressure acts on the top of this plunger to force it downward, but is not effective over the whole surface because pressure exists in the cushion chamber 4 and it is supposed to equal the outside pressure as it enters freely.

After the descending plunger has passed the point 5 the remaining air is trapped under the upper part of plunger, except what escapes through the valve 6. Suppose that the sudden descent of this plunger raises pressure in the air chamber 4 to 30 pounds, while the pressure acting on the upper surface is 14 pounds, making the mean effective pressure $30 - 14 = 16$ pounds per square inch.

Assuming the diameter of small part of plunger to be 4 inches, its area is 12.5 square inches. If the diameter of large, or upper part, is 8 inches, its area is 50 square inches. The surface on which 30 pounds acts is $50 - 12.5 = 37.5$ square inches. Then $37.5 \times 30 = 1{,}125$ pounds acting to arrest the plunger.

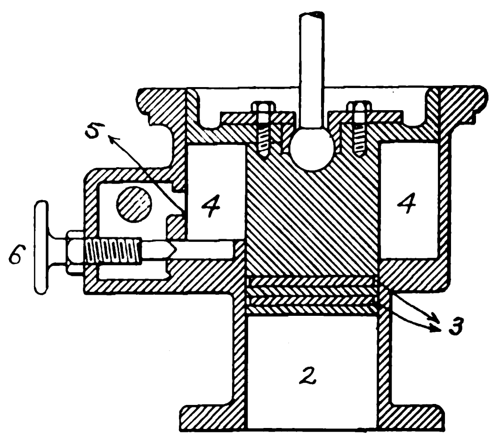


FIG. 4.

In reality it is more than this because pressure increases in the vacuum chamber 2 and this assists in stopping the plunger. It will be noted, however, that this action lasts but an instant.

A careful consideration of this chapter will show the reader that when the dash pot plunger of a modern Corliss engine is started from a state of rest it is comparatively light, but when the time arrives for it to close the steam valve, it is to all practical purposes much heavier.

In this case the rod is attached to the plunger by means of a ball and socket joint which permits the rod to swing in any direction. It also permits the plunger to turn in its cylinder.

When wear due to long service causes lost motion at this point, it may be taken out by loosening the cap screws shown at either side of the ball joint, and moving the plates nearer together.

ELECTRICAL STATION PRACTICE.

ARTICLE XXVII.

BY W. H. RADCLIFFE.

An important modification of the dynamotor, discussed in the latter part of the preceding article, is the rotary converter. This machine forms as it were a link between alternating and direct current systems, being in general a combination of an alternating current motor and a direct current generator. Although of comparatively recent adoption, it has already gained such a foothold in certain classes of distribution from central stations that it has practically become a fixture in all large electric railway systems and in other installations where heavy direct currents of constant potential are required at a considerable distance from the generating plant. In such cases a rotary converter is installed in the sub-station and being simpler in construction, higher in efficiency, more economical of floor space, and lower in price than a motor-generator, set consisting of an alternating current motor and a direct current generator which might be used in its place, it has almost entirely superseded the latter machine for the class of work mentioned.

There are two types of rotary converters, one of which has its field poles excited by a current which is induced in the field winding, while the other has its field poles excited by passing a direct current through the field winding. Owing to the great sensitiveness of the induction type of rotary converter to the conditions of the circuit in which it is connected, its operation is rendered more or less difficult under ordinary circumstances, so that the direct current type is almost universally employed for commercial purposes. The direct current rotary converter will, therefore, be the only one to which we will devote our attention. In order to understand the principles of this machine it is necessary to bear in mind that in every dynamo an alternating current is generated, which in an alternator is drawn from the armature winding without change by means of collector rings, and in a direct current generator is drawn from the armature winding by means of a commutator which by reversing the alternations at frequent intervals produces a direct current in the connecting wires.

For the purpose of illustrating the principles upon which the operation of rotary converters in general is based, reference will be made to the four-pole, single-phase converter shown diagrammatically in Fig. 27. The two views represent opposite sides of the same field magnets, N, S, etc., and of the same armature c, at A being shown the alternating current end of the armature and at B its direct current end. At first let us consider simply the end A, disregarding for the present the connections at the opposite end B. It is seen the armature winding is connected at four equidistant points, h, f, k, and l, to two collector rings v and z; upon a closer examination it is apparent that of the four equidistant points in the armature winding those which are subject to the same magnetic conditions are connected to the same collector ring. Thus, the armature coils directly beneath the two north poles N and N are joined to the same collector ring, while those directly beneath the two south poles S and S are both joined to the other collector ring. If the magnetism in the poles be maintained as indicated in the diagram, and the armature c be rotated, a single-phase alternating electromotive force will be developed between the wires b and d. On the other hand if a single-phase alternating electromotive force be supplied to the wires b and d, and the magnetism in the poles be maintained as before, the armature after being started will continue to rotate and this part of the machine will operate as an alternating current motor.

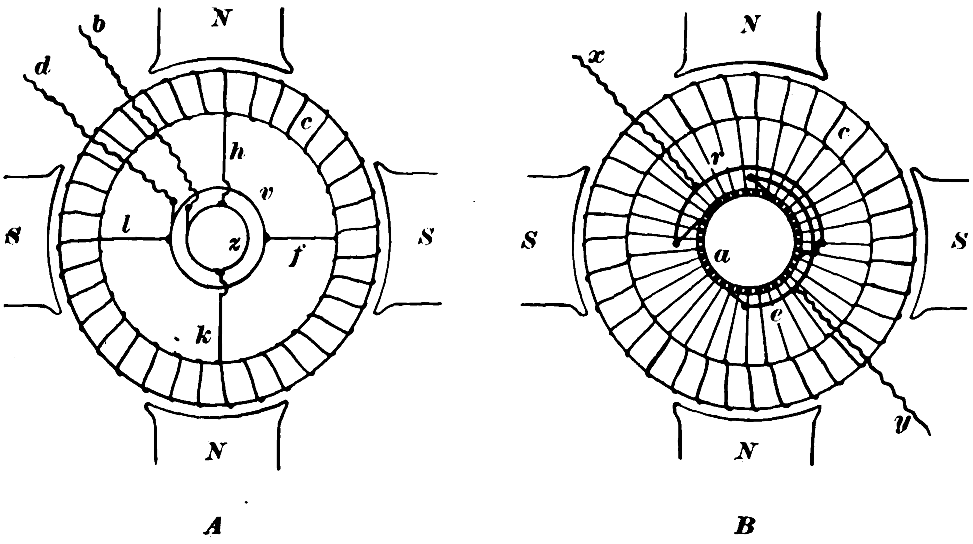


FIG. 27.

In the armature winding there is besides the alternating current fed into the machine an alternating electromotive force maintained by the rotation of the armature winding past the magnet poles. The conditions are therefore similar to those in any direct current generator, and when the armature winding is connected at the opposite end to the bars of a commutator a in the usual way, brushes pressing on the commutator a will deliver to the bus bars r and e and thence to the leads x and y a direct electromotive force which will cause a direct current to pass through any closed circuit connected to xy. The result is therefore the same as though the alternating current which is fed into the armature for causing rotation were the current actually generated in the armature, although in reality these two currents oppose each other; this fact, however, does not in the least affect the respective functions performed by each of the currents, for the machine acts as though it cared not, so long as there was alternating current in the armature winding, whether this current were that fed into it through the collector rings or that developed in it through the ordinary process of induction.

There is a serious objection, commercially, to the single-phase rotary converter which has here been chosen for illustrating the principles of converters as a whole. This objection is that common to all single-phase motors, and is the special means that must necessarily be employed for starting machines of this type from rest. This objection, however, is overcome when two-phase or three-phase connections are used in the motor, so that in practice single-phase converters are very seldom employed. Inasmuch as the general principles of operation in all converters are the same, the single-phase type was taken for illustration on account of its simplicity.

The only difference between the construction of single-phase converters and two-phase converters is that in the latter the armature winding between each pair of poles is connected in succession at four equidistant points to four collector rings so that there is in each section of the armature winding, bounded by a north and a south pole, two complete circuits terminating at the four collector rings; whereas, in a single-phase converter, there is in each similar section of the armature winding but one complete circuit terminating at two collector rings.

In three-phase converters each section of the armature winding lying between a pair of poles is connected in succession at three equidistant points to three collector rings so that there is from the motor side of this machine three complete circuits through that portion of the armature included between each north and south pole. In both two-phase and three-phase converters, the armature connections on the generator side do not differ from those shown in Fig. 27 for the single-phase converter. In many converters the field magnets are compound wound to facilitate different loads being carried without a decrease in voltage, although those employed on short distance distributing lines are shunt wound. The series coils in compound wound converters are excited, of course, by the direct current generated in the machine, while the shunt coils are excited with direct current from a separate source.

The rotary converter is a reversible machine; that is, if it is supplied with direct current of the proper voltage at its commutator end it will run as a direct current motor and deliver alternating current to the collector rings. While this feature is sometimes taken advantage of in starting the converter from rest, as will be shown later, the machine is not often used permanently in this way, its commercial application being usually the conversion of alternating currents into direct currents. When driven by direct current, however, the machine operates in every respect like a direct current motor, its speed of rotation depending upon the relation existing between the strength of the field and the direct current voltage applied. If the field be weak with respect to the magnetism resulting from the applied voltage, the armature will rotate at a high speed, increasing until the conductors on the armature cut the lines of force in the field so as to develop an electromotive force which will be equal to that applied. On the other hand, if the field be strong with respect to the magnetism resulting from the applied voltage, the armature will rotate at a low speed. If, therefore, it be desired to operate the converter in this manner and maintain an alternating current of constant frequency, the speed of rotation must be kept constant by supplying a constant voltage not only to the brushes pressing on the commutator, but also to the terminals of the field winding. When the converter is driven by alternating current it runs as a synchronous motor; that is, it operates in synchronism or in step with the alternator supplying the current, and its speed of rotation is governed by the frequency of the alternator.

The commutator of the rotary converter is its most troublesome part, for owing to the many pieces of which it is composed and the necessary lines along which it is constructed its peripheral speed must be kept within reasonable limits. The peripheral speed of the commutator in feet per minute is the circumference of the commutator measured in feet and multiplied by the number of revolutions per minute. Experience has shown that a rotary converter should not be run so as to give a peripheral speed of the commutator exceeding 3,000 feet per minute, else the centrifugal force developed will be liable to cause the commutator to fly apart. Another limitation imposed is the voltage between adjacent commutator bars, and in value this should not exceed eight or ten volts to give satisfactory results; furthermore, if the commutator bars are made narrow in order to obtain the necessary number for the desired voltage with the minimum circumference and therefore low peripheral speed, the brushes employed to collect the current are liable to require excessive width in order to provide the proper cross-section and yet not cover more than two bars at once. Assuming, therefore, that the usual practice be followed in giving the commutator bars a reasonable width, the peripheral speed of the commutator must be kept within the limit previously stated by feeding the converter with alternating current of a comparatively low frequency. For a rotary converter delivering 500-volt direct current, the proper frequency for the alternating current circuit has been found to be 25 cycles per second.

When the rotary converter is operated in the usual manner on an alternating current circuit, the direct electromotive force developed can be varied from zero to a maximum by changing the value of the alternating electromotive force supplied to the machine, or it may be altered within a limited range by moving the brushes around the commutator, or in a compound wound converter by changing the amount of compounding. Under ordinary conditions, varying the voltage developed by changing the voltage at the motor end is not practical, so it is seen from what has just been stated that the voltage developed can be varied only over a limited range. In addition to this, the voltage developed at the direct current end always bears a certain constant proportion to the alternating current voltage applied at the motor end; this is due to the same winding being used both for motor and generator purposes. In all cases the proportion is such that the alternating current voltage is the lower, being in the single-phase and in the two-phase converters about .707 of the direct current voltage, and in the three-phase converters about .612 of the direct current voltage. It is thus seen that whatever value of direct current voltage is desired the value of the applied alternating current voltage must be lower, requiring in consequence the installation of step-down transformers at the sub-station for reducing the line wire voltage to conform to the direct current pressure required.

As to efficiency, the rotary converter may be said to have approximately the same value as that in the average direct current generator of the same output, although in reality the converter is a trifle more efficient on account of affording a somewhat shorter average path for the current in the armature, reducing in consequence the resistance loss and the armature reaction. These may be still further reduced by increasing the number of connections between the armature and commutator, although, as has previously been shown, there are certain limitations in this direction on account of the number of commutator bars exceeding their practical limit. Since there is ordinarily less resistance loss in the armature of a converter than in the armature of a direct current generator of the same output, the former may be overloaded to a far greater extent than the latter. Thus, a two-phase converter may be overloaded approximately 60 per cent., and a three-phase converter may be overloaded about 30 per cent. above the respective outputs of these machines if operated as direct current generators.

Electricity in Japan.

A great deal of activity is at present being shown in Japan in the utilization of electricity for lighting, power and traction purposes. The electric light works at Tokio (the capital) are not a new installation. They have been in operation for some considerable time with a measure of success which may be gauged by the fact that it has become necessary to greatly extend the power house. The plant at present installed has a capacity of 5,050 hp., and this is being increased by an additional 3,600 hp. Electric current is being supplied from the original plant to the equivalent of 100,273 10-cp. lamps, and we understand that the demand for

light is so heavy that applications for connections are received at the rate of over 1,500 a month.

The new plant is expected to be in operation in April next, and immediately on its completion work will be commenced on a further extension, which will ultimately increase the output of the station by 10,000 hp. A part of this scheme is to be realized by the summer of next year. Fresh demands for electric power are being made upon the electric light company by the light railway company, which is operating an extensive system of light railways in the city. In other parts of Japan there is evidence of similar progress in which the municipalities are taking a prominent part. For instance, one city proposes to develop close on 10,000 hp. by utilizing the power of the Tama River. This scheme provides for the harnessing of the water at three different places and the erection of an equal number of generating stations. Other places are going in for electric traction systems, such as Osaka, where the municipal authorities are seeking Government authority to lay down electric tramways as a municipal undertaking.

Another instance of activity in the same direction is the completion of the Keihin electric railway, which is under construction. It runs between Shinagawa and Kanagawa, a distance of about 20 miles. The company is laying down a power plant with a capacity of 540 hp., which will supply current for working the line, and an average speed of 50 miles an hour is to be maintained. It is likely to prove a formidable rival to the Government railway between Yokohama and Shimbashi, as it will have the advantage of a more frequent and rapid service.—*Electrical Engineer, London.*

SOME CRITICISMS ON WORKSHOP PRACTICE.*

BY E. KILBURN SCOTT, M.I.E.E.

When in the workshops one is apt to become so accustomed to the methods in vogue that they appear to be the only methods possible. As a matter of fact, however, many of them are at least open to question.

For example, take such a simple matter as the use of a keyhole saw; like every other saw it is made to cut on the pushing stroke, and one must needs be very expert to prevent it bending and snapping off. The difficulty would disappear if the saw were turned end for end, and the cutting done on the pulling stroke in the same way as a Japanese workman does his work.

This reminds the writer that whereas in a slotting machine the cutting stroke is in the direction of the bedplate on to which the work is temporarily bolted, a shaping machine, on the other hand, has its working stroke outwards, or away from the bed frame. Surely the tool ought to cut on the home stroke, as it would then not only make a cleaner cut, but the ram would be in tension instead of compression, and could be of lighter construction. It would probably also be easier for the attendant to see when he was cutting down to the scribed mark.

For machining large diameter alternator rings it is usual to employ a horizontal face plate lathe or boring mill, and as the diameters of alternator armatures have increased very rapidly of recent years, the distance between the uprights carrying the bridge have to be a considerble distance apart. Now, if instead of rotating the armature ring, the cutting tools are rotated, then these uprights can be done away with, and all that is required is a rigid central column to carry the cross-arm tool-holder. In this way any diameter of armature could be machined.

In winding copper wire on to a field coil it is usual to place a brake on the spindle of the spool which is being unwound so as to keep the wire taut. This naturally gives a good deal of side pull to the bearings of the lathe and there is considerable friction. Now, if two spools were to be wound on the same lathe and the wires lead on to the spools from opposite directions, say, top and bottom, these side pulls would be neutralized to a large extent.

There is also room for considerable improvement in winding coils, for the present tap-tapping of the wire with wooden mallets is anything but satisfactory. What appears to be wanted is a change gear, which at each revolution of the coil would move a small pair of gripping wheels the exact distance of the diameter of the wire. A knock-off reversing motion could be arranged to start the wire back again when it reached the end of each layer.

Soldering by hand with an iron is another of those finicking things which ought to be banished from an electrical engineering works. Where possible, all joints should be mechanical, but if solder must be used it might just as well be done wholesale by first dipping the parts into flux and then into melted solder. There is no reason why, with a little special designing, the joints between armature coils and commutator segments should not be made in this way; anything would be better than the present finicking messy handwork. In some Continental workshops the short-circuiting end rings of alternate current motors are soldered to the rotor conductors by dipping in an annular ring of melted solder.

In the manufacture of mica cloth and mica paper there is far too much handwork. Surely some machine method of laying on the thin laminæ in three layers to break joint could be devised. Compared with such a mechanical miracle as the Hoe printing press, or even an ordinary loom, it should be simple. If some firm gave their cleverest improver the problem to work out with ample facilities for experimenting, I'll be bound he would find a solution in quick time.

Instead of grumbling about the low prices now prevailing manufacturers should be continually devising short ways of doing the work, or if they cannot devise, then adopt the labor-saving dodges of others. I wonder how many shops in this country can show armature coil-tapping machines in use? To my knowledge, they had been used in the States and on the Continent four years before one was even tried here. Again, consider the amount of material which the English manufacturer buys ready made, for example, stampings, mica cloth, and even machine frames, spindles, etc., finished. Surely this is only half playing the game.

Prices are likely to go even lower, and for the smaller sizes to pay, they will have to be made as Singers make sewing machines or Kynochs make small arms. I wonder which firm will be first to paint their small castings by running them on an endless chain through a paint tank.

*From the "Electrical Review," London.

Demand for Submarine Boats.

The Electric Boat Company, it is claimed, has on its books orders for submarine boats the net profits on which will represent several hundred thousand dollars. Already the British Admiralty has bought 19 boats from the company, and this number, it is stated, is to be increased to 29 boats. A number of the Continental powers have purchased one or more submarine vessels from the Electric Boat Company and the United States Government has several in commission.

Underground Cables in Baltimore Fire.

The Baltimore fire has been the unfortunate means of settling many disputed points for the engineers of this country, and it has, among other points, emphasized most forcibly, in the minds of dis-

interested observers, the superiority of underground cables for electrical transmission of power as compared with old overhead methods.

The Standard Underground Cable Company has installed during the past few years in Baltimore many miles of underground cable, in the municipal subway for the Western Union and Baltimore & Ohio Telegraph Companies, the Maryland Telephone Company, the city fire and police departments and the United Railways & Electric Company. The main conduit lines run the entire length of the burned district and the manhole covers were in many cases covered with piles of hot brick and stone to a depth of 20 feet.

In spite of the intense heat there is so far as is known not a single instance of trouble on the cables in manholes or subway except where exposed ends of cables were destroyed by the fire, and the cable system is in perfect condition to-day.

Two three-conductor cables installed for the United Railways & Electric Company over a year ago, and which terminated in the new and unburned portion of the Partt street power house, extended the entire length of the burned district, and were carrying current to the substation at 13,000 volts, the second day after the fire, without any interruption to service.

This record compared with the ruin of overhead construction which was universal certainly gives food for thought to all users of wire.

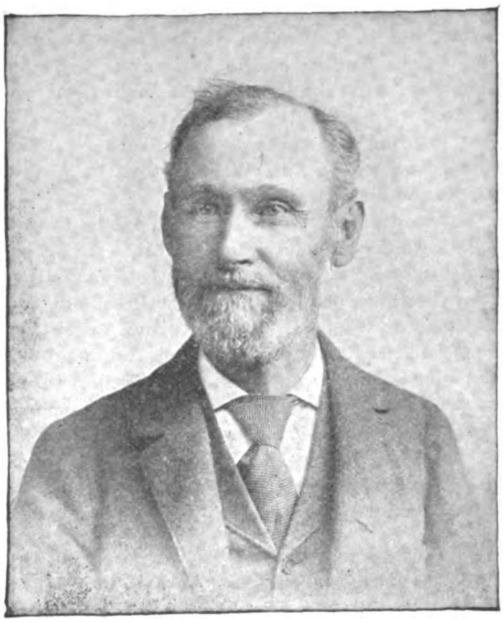
Death of Andrew Howard.

Andrew Howard, president of the Phoenix Glass Company, Monaca, Pa., died Saturday morning, February 27. He had only been ill about ten days. He was attacked with a species of grip, which developed into pneumonia. The funeral was held at his residence in Wilkinsburg on Monday.

Mr. Howard was born in 1837 in Pittsburg, and after a thorough mercantile education in the schools of that city was employed as a clerk with the transportation firm of Clark & Thaw, afterwards merged into the Star Union Line, of which Mr. Howard was made the first cashier. He resigned this position in 1880 to organize the Phoenix Glass Company for the purpose of manufacturing a patent glass insulator, which product was abandoned and the manufacture of lamp chimneys taken up. From this beginning, and through his enterprise and energy principally, has the Phoenix Glass Company grown to its present large proportions.

A man of wonderful tact, discretion and judgment, Mr. Howard was unassuming to the last degree, and beloved by everyone with whom he came in contact. His geniality and benevolence were so marked that it has been said of him, "If he has a fault it is that he is too kind." In his death the glass trade has lost an honored member, his associates and employes their best friend, and the world at large one of nature's noblemen.

Mr. Howard's popularity with the em-



ANDREW HOWARD.

ployes of the Phoenix Glass Company was evidenced by their attendance at the funeral, special trains being run from the Washington and Monaca factories. The floral offerings were expressive of the general high esteem in which the deceased was held, and came in profusion from his business associates, the Glass Manufacturers' Association and the employes.

ELECTRICAL PATENT RECORD.

LETTERS PATENT; ISSUED MARCH 1, 1904.

Electric Railways and Appliances.

753,341. Safety-Guard on Electrical Cars. Charles A. Willard, St. Louis, Mo. Filed Jan. 29, 1902.

753,387. Electric Train Order and Signaling System. John C. Gleason, Springfield, O., assignor of one-half to James B. Von Schriltz, same place. Filed July 24, 1903.

753,436. Safety Apparatus for Motor-Cars of All Kinds. Karl Schmidt, Cothen, Germany. Filed Oct. 12, 1903.

753,536. Contact-Device for Electrically-Propelled Railways. Henri Berthoud, Neuchatel, Switzerland. Filed July 10, 1902.

753,542. Trolley. Alexander O. Calderwood, Gloversville, N. Y. Filed Aug. 6, 1903.

753,552. Trolley for Electric Cars. William A. Daggett, Vineland, N. J. Filed Sept. 3, 1902.

753,554. Trolley. Arthur S. Deem, Reading, Pa. Filed Aug. 8, 1903.

753,617. Trolley-Replacer. Francis A. Nolan, St. Paul, Minn. Filed Jan. 16, 1902.

753,802. Combined Third and Traction Rail for Electric Railways and Switching Systems Embodying Same. Edmund O. Morgan, Chicago, Ill., assignor, by mesne assignments, to the Morgan Electric Machine Company. Filed Aug. 27, 1902.

753,803. Combined Third and Traction Rail for Electric Railways. Edmund C, Morgan, Chicago, Ill., assignor to the Morgan Electric Machine Company. Original application filed Aug. 27, 1902. Divided and this application filed Dec. 3, 1903.

Electrical Machinery and Apparatus.

753,243. Velocity-Meter. Georg Dettmar, Frankfort-on-the-Main, Germany, assignor to the Society of Electricitats Actien-Gesellschaft vorm W. Lahmeyer & Co., same place. Filed Sept. 12, 1902.

753,258. Electric Switch. Gerald W. Hart, Hartford, Conn., assignor to the Hart Manufacturing Company, same place. Filed Nov. 23, 1903.

753,278. Winding for Electrical Machines. Frederick J. Lindeman, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 11, 1903.

753,356. Brush-Holder. Charles O. Bulock, Milwaukee, Wis., assignor to the National Electric Company. Filed Aug. 21, 1903.

753,422. Armature-Winding. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company. Filed Nov. 11, 1902.

753,429. Electrodynamic Generator. George M. Pelton, Chagrin Falls, O. Filed Sept. 29, 1902.

753,461. Electrical Conductor and Coil. James C. Anderson, Jersey City, N. J., assignor to the Varley Duplex Magnet Company. Filed April 30, 1903.

753,533. Rheostat. John C. Barclay, New York City. Filed Sept. 9, 1903.

753,556. Electric Meter. Thomas Duncan, Lafayette, Ind. Filed Dec. 29, 1903.

753,704. Automatic Magnetic Circuit-Breaker. Frank O. Hartman, Mansfield, O. Filed April 10, 1902.

753,714. Conduit for Electrical Conductors. Hubert Krantz, New York City. Filed Sept. 9, 1903.

753,795. Electric Sparking Igniter for Explosive-Engines. William J. Hart, Mount Vernon, N. Y., assignor of one-half to Charles F. Splitdorf, New York City. Filed May 28, 1903.

Telephones and Telephone Apparatus.

753,252. Telephone Repeater. Merritt Gally, Brooklyn, N. Y. Filed March 18, 1903.

753,391. Casing for Telephones or Microphones. Paul Hardegen, Berlin, Germany. Filed Sept. 3, 1902.

753,411-753,412. Telephone Toll Apparatus. George A. Long, Hartford, Conn., assignor to the Gray Telephone Pay Station Company. Filed April 15, 1902, and Nov. 8, 1902.

753,466. Disinfecting Attachment for Telephones. Carlo Bravi-Bertini, Perth Amboy, N. J. Filed Sept. 16, 1903.

753,493. Telephone. Stephen O. Houghton, San Francisco, Cal. Filed April 3, 1903.

753,562. Jack-Field for Telephones. Lars M. Ericsson, Stockholm, Sweden, assignor to Aktiebolaget L. M. Ericsson & Co., same place. Filed June 18, 1902.

753,568. Portable or Table Telephone Instrument. Lars M. Ericsson, Stockholm, Sweden, assignor to Aktiebolaget L. M. Ericsson & Co., same place. Filed Sept. 30, 1902.

Miscellaneous.

753,240. Electric Alarm-Clock. Leslie H. Cushman, Lakewood, N. J. Filed Feb. 17, 1903.

753,284. Electrically-Propelled Vehicle. Hiram P. Maxim, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 4, 1903.

753,365. Electromagnetic Signal. William U. Colthar, Springfield, O., assignor to John C. Gleason and James B. Von Schriltz, same place. Filed July 24, 1903.

753,383. Process of Preparing Electrodes for Storage-Battery Cells. Oskar Frank, Detroit, Mich., assignor to Levi J. Lennox and the Michigan Storage Battery Company, same place. Filed May 2, 1903.

753,398. Cleat for Electric Wiring. Emory C. Hunt, Belle Plaine, Ia., assignor of one-half to Charles W. E. Snyder, Benton County, Ia. Filed Nov. 8, 1902.

753,399. Combination Bracket and Knob for Electric Conductors. Emory O. Hunt, Belle Plaine, Ia., assignor of one-half to Charles W. E. Snyder, Benton County, Ia. Filed Nov. 8, 1902.

753,509. Electrotherapeutic Device. Charles K. Munns, Corning, Ia. Filed Oct. 24, 1903.

758,690. Electric-Telegraph Apparatus. Agazio Falcone, Florence, Italy. Filed May 6, 1903.

753,757. Self-Winding Electric Clock. Frank T. Talcott and Benjamin F. Kerr, Ashtabula, O. Filed March 11, 1903.

753,759. Electrical Connection. Edward G. Thomas, Cambridge, Mass. Filed July 15, 1902.

753,819. Electrode. George J. Atkins, Tottenham, Eng. Filed April 8, 1903.

THE TELEPHONE WORLD.

Pushing Automatic Telephones in Massachusetts.

The opening move in a project to extend the automatic telephone system throughout Southeastern Massachusetts and Rhode Island is the incorporation of a new company known as the Automatic Telephone Equipment Company. The new corporation is nominally distinct from the companies which now maintain exchanges in New Bedford and Fall River with connections between the two, but the incorporators are to a large extent stockholders of the New Bedford and Fall River concerns, and the new company will co-operate with the old in establishing new exchanges and a long-distance service in that section of New England.

The Equipment Company, like the companies now using the automatic system, will obtain privileges from the main company in Chicago for Massachusetts and Rhode Island.

The stockholders of the new company are in a large measure holders of stock in the company which is now carrying on business. They, like the company now operating the system, will, of course, obtain the privileges of the system from the main company of Chicago.

Among the incorporators of the new company are Charles E. Hellier, Frank E. Sweetser and Charles B. Price of Boston; Benjamin E. Waters, Congressman William S. Greene of Fall River, and many other Fall River and Taunton mill men and capitalists.

The Farmers' Telephone Company at Anderson, Ind., has adopted a general signal of distress for its patrons on party lines. Following the general alarm the exchange operator will give the number of rings indicating the house from which the alarm came, so that the neighbors may go direct to the place where assistance is needed.

I. M. Griggsby of Goss, Mo., president of the Monroe Mutual Telephone Company, met about 75 farmers in Monroe City lately, and formed a mutual company that will work in exchange with the county lines. The farmers appear enthusiastic and start out with bright prospects for the future.

The Washington Telephone Company has contracted with F. H. Colson of Wesley, Me., for 200 telephones to be delivered before June 1. The company proposes to build a line to Roque Bluff, Wesley and Cathance Lake in that State.

The Selma, Ind., Co-operative Telephone Company lately held an important meeting there, and decided to purchase property for a permanent home, to buy a new switchboard and to otherwise improve its plant and service.

There is now only one telephone corporation doing business in Mount Vernon, N. Y. The Telephone, Telegraph & Cable Company of Eastern New York has been driven out of business there.

The Western Wisconsin Telephone Company of Arcadia, by Senator John C. Gaveney, president, and Emil Maurer, secretary, recently filed an amendment increasing the capital stock from $40,000 to $50,000.

Independent Telephone Companies Object to Postmaster General's Order.

The Toledo, O., Home Telephone Company, through its president, E. L. Barber, has joined the list of protesting Independent companies in a determined effort to have the recent order of Postmaster General Payne revoked. This order shuts the Independent companies out of all postoffices in the country.

A committee of three, of which Mr. Barber is one, and F. S. Dickson of Cuyahoga County, and Cyrus Huling of the Columbus Citizens' Company, are the other two, has been appointed to personally see President Roosevelt and ask his interference in the order. The committee will go to Washington in a few weeks and make the protest.

This contest between the Independents and the Postoffice Department promises to be an exciting one. Already written protests against the order have been made to the President and Postmaster General. The original order has been slightly modified, but the Independents consider it unfair and a menace to their interests. They want the order recalled. A perfect organization of all the Independent companies of the State has been formed. Congressmen have been petitioned to exert their influence to have the order revoked.

The Garfield County Telephone Company held its annual meeting at New Castle, Col., a short time ago and elected the following officers: President, William Chadwick; vice-president, E. E. Clarkson; secretary, W. D. Lockard; treasurer, J. A. McRae; general manager, J. S. Kass. The company has 120 telephones. The line will be extended to Glenwood Springs next summer. The incorporation of the company was authorized at the meeting.

In spite of numerous injunctions and other obstructions thrown in its way, the Independent Telephone Company has at last succeeded in getting a long distance connection between Binghamton and Elmira, N. Y., and in that way with a large number of other cities in this State, Pennsylvania and Ohio.

The farmers of Daleville, Ind., have failed to organize a telephone company which has been talked of for some time, and now the Delaware-Madison Telephone Company has announced that it has already purchased a part of the material for a local plant and will begin construction work as soon as the weather will permit.

The people of Alma, Mich., have been enjoying the fruits of a war between the Michigan State Telephone Company and the Union (Independent). The Bell Company has been branching out rapidly and the Union offered free 'phones to Alma and St. Louis. The Bell Company is now doing the same.

A report has been received from Princeton, Ind., that the Independent telephone service there is so much superior to the Bell that many Bell subscribers are having their telephones taken out and Independent telephones installed.

The Chicago Telephone Company for February shows a gain of 1,724 instruments, making the total number in use 104,368.

Recent communication from Papillion, Neb., states that an independent telephone company has been organized among the farmers of Plattford precinct. It is known as the Mutual Telephone Company and has 16 charter members. The following are its officers: W. D. Schaal, president; Dan Phelps, vice-president; J. H. Bundy, secretary; Z. T. Garman, treasurer. The farmers will do the construction work with the aid of an electrician. Work will be commenced as soon as warm weather opens up.

Parties have been in Rice Lake, Wis., several times of late looking over the situation regarding a new telephone system in that city. Eau Claire people are said to be interested in the proposition and a fight will probably be made for a franchise. The local people have interested themselves in the movement to a certain extent and it is said that if a franchise can be secured the work of putting in the line will be begun at once. If put in it is expected that connection will be made with Chippewa Falls, Eau Claire and other points in the vicinity.

The movement recently set on foot in Chesterfield, Va., for organizing a local telephone company to effect a telephone system connecting the Court House with Chester, Kingsland, Drewry's Bluff and perhaps other points, is progressing well and assuming business-like shape. E. W. Ellison, of Chesterfield, has been one of the most active and enthusiastic promoters of the movement, and has succeeded in interesting citizens enough to unite as a joint stock company and begin operations as soon as a charter can be secured.

At the close of the convention of the Michigan Independent Telephone Association the following officers were elected to serve during the year, the only changes made being in two members of the executive committee. The complete list follows: President, E. B. Fisher, Grand Rapids; vice-president, R. B. McPherson, Howell; secretary, C. F. Brown, Alma; treasurer, R. F. Johnson, Saginaw. These, with William Robinson, Muskegon; W. O. Hunt, Adrian; J. Robinson, Benton Harbor; A. E. Palmer, Kalkaska, and W. E. Wing, Grass Lake, constitute the executive committee.

The Morning Star Telephone Company is to operate in Crawford, Orange, Dubois, Perry and Harrison Counties, Ind. Its directors are Joseph Allen, W. H. Williams, W. J. Trusty, C. E. Newkirk and G. W. Wilson.

Telephone Incorporations.

The Middletown Home Telephone Company Middletown, O. Capital stock, $10,000. Incorporators: Albert Emanuel, Charles N. Bosler, N. P. Ramsey, Robert E. Cline and H. P. Miller.

The Glidden Telephone Company, Glidden, Wis. Capital stock, $24,000. Incorporators: J. R. Whitaker, W. L. Schuppert and four others.

The Faller Automatic Telephone Exchange Company, New York City—to manufacture telephone apparatus. Capital stock, $10,000. Incorporators: James W. Chisholm, Clarkson Clothier and Ernest A. Fuller.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aberdeen, Miss.—The Aberdeen Electric Light & Power Company has been incorporated with a capital of $15,000, by E. M. Jones, J. R. Jones, C. C. Stubbs and others.

Alton, Ill.—The proposition of J. F. Porter to light this city with electric lights for the coming year is being discussed.

Braddock, Pa.—The movement for an electric light plant here has gained ground since the election.

Campeche, Mex.—This city is to have an electric light system and the machinery will soon be ordered from the United States.

Cardington, O.—The Cardington Electric Light, Heat & Power Company, has been incorporated with a capital of $15,000.

Charlotte, N. Y.—The matter of improving the electric light and waterworks plant is being discussed by the taypayers of this city.

Clifton Springs, N. Y.—At a public meeting lately held here it was moved and carried to request the village board of trustees to submit two propositions at the election on March 15, one proposition to the effect that a sum not exceeding $18,000 be raised by tax for the purpose of building and equipping an electric light plant, and the other that the sum of $3,500 be raised by tax for the purpose of lighting the village by electricity oa a contract.

Drayton, N. D.—This village may secure an electric lighting plant.

East Lake, Ala.—The citizens will vote on March 28 upon the question of the issue of $13,500 of bonds for the purpose of building an electric light plant.

Fort Branch, Ind.—W. C. Polk and associates are interested in the proposed new electric light plant.

Garden, Mich.—The village council has granted a 20-year electric light franchise to local men and a plant is to be installed soon.

Gobleville, Mich.—A petition is being circulated asking the village council to call an election to vote on bonding the village for $20,000 to put in an electric light and waterworks plant.

Groton, S. D.—A franchise for an electric light, gas and central heating plant here has been granted to Herman E. Miles, of St. Paul, Minn.

Kalama, Wash.—The Kalama Electric Light & Power Company will have the 900 hp. electric plant completed in about two months.

Kensington, Md.—The matter of bonding this city for $50,000 for waterworks, sewers and an electric light system was lately recommended by the mayor and council.

La Grande, Ore.—The Oregon Power & Development Company has been incorporated with $250,000 capital, and proposes to begin the installation of a 7,000 hp. electric light plant on the head water of the John Day River early this spring. F. E. Hobson, F. S. Slater and Z. J. Martin are interested.

Laton, Cal.—The chamber of commerce is considering the formation of a company to erect an electric light plant here. E. P. Blanchard and A. G. Smith are interested.

Lincoln, Neb.—An ordinance is before the council to vote on a bond issue at the April election for a municipal electric lighting plant.

Lockport, N. Y.—A resolution has been passed by the common council directing an election on a proposition to install a municipal electric lighting plant in this city at a cost of $50,000.

Mechanicsville, Ia.—D. C. Gilliland has purchased the electric light plant.

Middletown, Ill.—This city will soon be equipped with an electric light plant.

Minot, N. D.—It is reported that an extended addition to the Minot electric light plant may be made this spring.

Monticello, Wis.—The village board has adopted resolutions in favor of bonding the village for $8,000 to build and operate an electric light plant. The citizens will vote on the proposition March 11.

Needles, Cal.—A franchise for an electric pole line system has been granted to Daniel Murphy, and he proposes to install an electric light and power plant here.

Ogden, Ia.—Bids will be received until March 15 for the erection of a light plant for the town. Plans and specifications may be had of J. M. Rosen, village recorder.

Oxford, N. Y.—Local men are considering the advisability of installing an electric light plant to light the town from the north end to the Webster line.

Port Lavaca, Tex.—A new electric light and ice plant will be installed here by C. J. Spittol.

Santa Clara, Cal.—A new incandescent system of lighting will be constructed here. The estimated cost is $5,000. E. E. Moore is city engineer.

Sedalia, Mo.—Mayor Babcock will soon lay before the city council plans for an electric lighting plant.

St. James, Mo.—Charles W. Orendorf and J. W. Scott, of St. Louis, were lately granted a franchise from the council of this city, for the putting in of an electric lighting plant.

St. Paul, Minn.—The Union Manufacturing Company of St. Anthony's Park, whose electric light plant was recently destroyed by fire, will be rebuilt at once.

Valatie, N. Y.—This village proposes to construct an electric light plant to cost $12,000. E. Lasher is village president.

Valley City, N. D.—A new electric light plant is being discussed here.

Warrensburg, Mo.—This town will soon vote on the proposition to own its electric light plant.

Xenia, O.—Harry L. Canfield, manager of the Delphus Electric & Power Company, has petitioned for a franchise to establish a light plant here.

Yreka, Cal.—C. H. Morrison states that two electric light and power plants, one 23,000 hp., and the other 400 hp., will be constructed here.

STREET RAILWAYS.

Allentown, Pa.—The Blue Ridge Electric Passenger Railway Company is trying to secure the right to enter this city.

Columbia, Ky.—W. K. Azbill is one of the promoters of the new road to be built from here to Lebanon.

East Aurora, N. Y.—The Buffalo & Southeastern Railway Company has made application to the city council for a franchise to build an electric line from Main street to Buffalo.

Eddyville, Ia.—The Chicago, Ottumwa & Eastern Electric Railway Company is the name of a new company just formed here to build a line between Council Bluffs and Ottumwa.

Lake City, Ia.—E. E. Ferris, an electric railroad promoter, with J. G. White & Co., of New York, has closed his Marshalltown contracts and announces that he will come here soon to promote a line from here to Rockwell City and Carroll.

Meridian, Miss.—The Meridian Light & Railroad Company has increased its capital stock to $1,000,000, and will issue $750,000 worth of mortgage bonds for the improvement of the property. An entirely new power house with most modern electrical machinery is to be installed.

Newburgh, N. Y.—Edward Winters is trying to secure a franchise to erect a new trolley line.

New Haven, Conn.—Stockholders of both the New York, New Haven & Hartford Railroad and the Fairhaven & Westville Railroad Company, which controls all the trolley lines in this city, have stated that a deal by which the former company acquires the latter has been practically completed.

New York City.—Robert E. Robinson of Dick & Robinson, the firm that is financing the Westchester Railroad Company, states that the road will be operated by electricity, and that the equipment will be similar to that of the subway. If the plans of the company are carried out it will be able to run its trains from either White Plains or Port Chester to the New York City Hall.

Scranton, Pa.—A franchise is being sought by the Scranton & Dalton Electric Railway Company to build a line through to Factoryville.

St. Louis, Mo.—It is reported that the St. Louis Transit Company will issue $8,000,000 new bonds, of which $4,000,000 will be subscribed for in St. Louis, $2,000,000 in New York and the remainder abroad.

Summit, N. J.—The Cross Steam & Electric Railway Company has made application to the common council for trackage rights.

POWER PLANTS.

Charlotte, N. C.—Whitney & Stephenson are at the head of a syndicate about to begin the construction of an immense power plant near here, to involve a total expenditure of about $5,000,000.

Irapuato, Mex.—An electric power plant will be installed here by Richard A. Barkely to furnish power for operating his flour mills, paint works and other industrial concerns.

BIDS WANTED.

Phoenix, Ariz.—The Commissioner of Indian Affairs is inviting sealed proposals until March 23 for furnishing the United States Indian School here with a quantity of electrical material, including wire, insulators, switches, plugs, rosettes and sockets, dry batteries, etc., a full list of which, together with the necessary blank forms of proposal, may be obtained upon application to Charles W. Goodman, superintendent of the school.

NCTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅜@12½c.; Lake 12½@12⅝c.; casting, 12¼@12⅜c.

The politicians seem to be "playing" with Brooklyn Rapid Transit and Consolidated Gas.

The Philadelphia Traction Company has declared the regular semi-annual dividend of $2 per share, payable April 1 to holders of record March 11.

Announcement is made that the New York and Ottawa Railroad, which will be sold at foreclosure in June, will be converted into an electric line.

The Capital Traction Company of Washington, D. C., has declared the regular quarterly dividend of 1¼ per cent., payable April 1. Books close March 14 and reopen April 1.

The Boston & Albany has asked leading electrical companies for bids for the electrical equipment of the "Newton Circuit." The cost of this equipment will be about $2,000,000.

The Twin City Rapid Transit Company has declared the usual quarterly dividend of 1¾ per cent. on its preferred stock, payable April 1. Books close March 19 and reopen April 2.

The directors of the Hudson River Telephone Company organized on Saturday at Albany, N. Y., with U. N. Bethel, a representative of the American Telephone & Telegraph Company as president.

The Interborough Rapid Transit Company of this city has declared a quarterly dividend of 1½ per cent. on the Manhattan Railway Company lease, and an extra dividend of 1 per cent.

Judge Holt of New York appointed as receiver of the Geneva Electric Construction and Equipment Company James R. Sheffield, with a bond of $5,000. The assets are said to be about $15,000.

Plans for the consolidation of the Utica and Mohawk Valley Traction Company and the Syracuse Rapid Transit Company are being worked out, a conference of capitalists having taken place in New York recently for this purpose.

According to an official of the Union Traction Company of Chicago the earnings since January 1 have just about held their own compared with a year ago. Severe weather and loss of theater travel have had their telling effect.

It is stated from Toledo that the Lake Erie, Bowling Green and Napoleon Electric Railway Company has issued and sold $1,000,000 five per cent. 30-year gold bonds, the money to be used to extend the present line to Fort Trenton and Napoleon.

The New York, New Haven & Hartford Railroad Company has issued an official denial that the company has under consideration the purchase of the Connecticut Railway & Lighting Company, which controls the traction system of Bridgeport, Conn.

The American Telephone & Telegraph Company will take $1,200,000 of the Bell Telephone Company's, of Canada, new $2,000,000 issue. The rights to the new stock are selling in Montreal at 2½, and the stock there has declined from 145 to 138, owing to the new issue.

A. D. Nast has succeeded Elmer Washburne as director of the Strowger Automatic Telephone Exchange, and A. G. Wheeler, Jr., succeeded M. Sello as vice-president. President Washburne expresses confidence that the dividend rate of 50 cents quarterly will be doubled this year.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Mar. 7
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	143¼
Metropolitan Street Railway	114
Metropolitan Securities	84
Ninth Avenue	200
Third Avenue	120
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	40¼
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	63
Philadelphia Traction	97¼
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	140
West End Street, com	90½
do. do. do. pref	109
Chicago.	
City Railway	165
North Chicago	87
Union Traction, com	5
do. do. pref	30¼
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	24
do. do. pref	54
Electric Lead Reduction	⅞
Electric Vehicle, com	8
do. do. pref	12
Westinghouse, com	165
do. pref	194
General Electric	160
Boston.	
Edison Electric Illuminating	234
General Electric	161
Massachusetts Electric Companies, com	21
do. do. do. pref	73¼
Westinghouse Electric & Mfg., com	79
do. do. do. pref	90
Chicago.	
Chicago Edison	152½
National Carbon, com	25
do. do. pref	99½
Philadelphia.	
Electric Company of America	7¾
Electric Storage Battery, com	55
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	121¼
Western Telephone Company	11
New England Telephone Company	119
New York.	
American Telegraph & Cable Company	84¾
Commercial Cable Company	191
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88
Miscellaneous.	
Chicago Telephone Company	118
Tel., Tel. & Cable Company of America	78
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	33
Consolidated Car Heating	64
Standard Underground Cable	200

ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

A Two-Dollar Tax.

During the latter part of 1899 the question was raised as to whether electric current brought into the United States from a foreign country was dutiable. The matter was brought up at that time by the Niagara Falls Power Company of Niagara Falls, N. Y. The company was worried for fear it would be driven against the wall by the Ontario Power Company, situated on the Canadian side of the Falls.

The question as to whether electric current generated in Canada and used to operate machinery in the United States was subject to a tariff duty was a rather difficult one for the Treasury Department at Washington to decide. But following the rule of the Great Napoleon, who used to say, "When in doubt, do nothing," the department did nothing.

But this inaction did not exactly please the generators of electricity in this State and as a result a bill has just been introduced into the Legislature at Albany which provides that any foreign corporation leasing, selling or transmitting electricity from a foreign country into this State shall pay a tax of $2 on every horse power generated and sold in this State. This is of course aimed at the Niagara, Lockport & Ontario Company, which at present is manufacturing electricity on the Canadian side of the Niagara River and sells its product to Buffalo, and also at a couple of other power concerns at Niagara Falls, soon to be put in operation, which propose to furnish electricity for power in this State, and another at Cornwall on the St. Lawrence.

It is doubtful if the bill ever becomes a law, but it would seem too bad that the American companies *on the spot* cannot successfully compete with foreign companies who are obliged to run much longer cables, involving a greater financial outlay.

* * *

Cleveland Wants a Pure Water Supply.

Many communities are troubled with impure drinking water and various attempts have been made in the past to kill the bacteria and render the water sterile without however impairing its taste.

The city of Cleveland, O., has taken up the question of a pure water supply and its Council is engaged discussing the advisability of making use of electricity as the sterilizing agent.

Referring to the subject City Electrician John Dunn is reported as saying:

"The plan is extremely simple. I have been assured that the passage of a strong electrical current through the water is sufficient to destroy the germs. It accomplishes this result as certainly as does boiling. To electrolyze the entire water supply of Cleveland is not a difficult matter. It could be accomplished at a very small expense.

"At present no reservoirs are being used, and the water is pumped directly from the pumping station to the consumers. It would be necessary to utilize one of the reservoirs. Then a powerful electric current could be introduced. This would destroy the germs, but it would not make any chemical change in the water. The alkalis which give taste to water would still remain, and the 'flat' taste of boiled water would be avoided. Then the water could be sent directly from the reservoir to the consumers."

It is not quite as simple a matter to purify water by electricity as the above remarks would lead one to believe. However, it has been done and is done successfully at the present time.

Off hand we should think that the so-called Tindal system would be the best

for a city such as Cleveland. This consists in forcing air that has been subjected to the action of a high tension electric current, and thereby ozonized, into the water to be purified. The statistics of a plant of this nature which has been for some time made use of for purifying a portion of the water supply of Paris, in France, show that it costs but .028 of a cent to sterilize about one cubic yard of water, according to which the whole of the Cleveland supply could be treated for probably about $100 a day, which is by no means an exorbitant figure when the beneficial results attained are taken into consideration.

* * *

Patents on Artificial Fuels. There is more thought given to the production of artificial fuels than is generally supposed. We have from time to time referred in these columns to various artificial fuels that have been tried abroad, but that many an inventor on this side of the Atlantic has given the subject his attention is attested by a chapter on artificial fuels in Edward W. Parker's report on "The Production of Coal in 1902," which is about to be published by the United States Geological Survey as an extract from the annual volume of Mineral Resources.

Prior to 1902, about 400 patents had been issued in the United States on artificial fuels, but up to the close of 1901 none had proved a commercial success. Mr. Parker gives a list of United States patents granted since January 1, 1902. It remains to be seen whether any of them will be successfully developed. The list includes 37 patents, but contains no mention of fuels made from petroleum or petroleum residue unless used in connection with coal, lignite or peat. Neither does it include any compounds that have for their object the increase of fuel efficiency unless they are used in the manufacture of the fuel itself. Three patents were used on briquetting machinery.

The steady advance in the price of coal —no less than 40 per cent.—which has taken place since 1898 has stimulated experiments looking to the invention of artificial fuels. Results obtained in foreign countries from the use of lignite and peat in briquetted form should encourage producers in the United States to try similar methods of manufacture. Small sizes of anthracite coal formerly wasted are indeed recovered now by washeries from the old culm banks and utilized. A large amount of coal lost in the form of dust or finely pulverized material might also be put into convenient shape for domestic consumption and slack now wasted at many of the bituminous mines in the United States might be used to advantage if compressed into briquettes. There are many indications that the time is not far distant when these neglected fuel resources will all be utilized.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The fourth annual convention of the Iowa Electrical Association will be held at Des Moines April 13 and 14.

The new "musical" scrapers on the elevated railroad cars in Manhattan were subjected last week to their first really severe test and were found wanting. As the sleet fell on the rails it froze and a thin film of ice was formed on the track. The shoes glided over the coating without picking up current and the scrapers made about as much impression on the coating as the shoes. As a result traffic was delayed and trains stalled.

Electric tramway cars in Rome, Italy, are now fitted with postal boxes, the contents of which are collected every quarter of an hour.

The committee of experts sent by the Pennsylvania Railroad Company to England, Scotland and Continental Europe to investigate signal and telegraph systems reports that the methods in vogue in this country are superior, on the whole, to those of the countries visited.

By May 1 Manhattan Island will be a wireless borough, so far as overhead cables are concerned. The one remaining line, that running from 125th street down the west side, will be put underground in six weeks.

As an indirect consequence of the Marienfelde-Zossen high-speed electrical railway trials, experiments are being made on a number of German railway lines with a view to investigating the working conditions of a steam railway service with increased speeds, says the London *Electrical Engineer*. On the Cassel-Hanover line, for instance, the trains tested are made up of gigantic high-speed locomotives and solidly connected six-axle cars, warranting a mean speed as high as 81 miles per hour. This speed would enable the journey between Berlin and Hamburg to be completed in about two hours, and it is stated that two such trains would be sufficient to cope with the present traffic. In the case of these experiments giving satisfactory results, it is thought probable that next summer some specially suitable lines will be arranged for a similar increased speed service, the more so as the Berlin-Zossen trials have shown existing permanent ways (provided they be fitted with heavy rails) to be fully suitable for a similar service. Even in the case of the introduction of electric high-speed railways being postponed for economical reasons, a material improvement in the German high-speed railway service may therefore be anticipated as far as lines with especially dense traffic are concerned.

The employes of the Russian Westinghouse Company have donated one per cent. of their wages for war purposes, amounting to $300 monthly. The company has given $5,000 and will duplicate the monthly offering of its employes.

Power sufficient to operate practically every industry in Duluth, Minn., is to be developed through the harnessing of the headwaters of the St. Louis River.

William Barclay Parsons, chief engineer of the Rapid Transit Commission of this city, will leave New York on March 29 with his fellow members of the Panama Canal Commission. He will return from the Isthmus in time to leave for London in April. He has been appointed one of a commission to examine and recommend transit improvements in that city.

Prof. Charles P. Steinmetz, in speaking before the Labor Lyceum in Schenectady, N. Y., a short time ago, approved the idea of an electrical night school there

It was announced semi-officially Friday that the long-delayed opening of the rapid transit subway of this city will take place early in June. Work on the elaborate programme has already begun, and the speakers selected have been notified of the parts which they will be expected to take. Among the speakers will be Mayor McClellan, President Orr of the Rapid Transit Commission, August Belmont, Chief Engineer Parsons and Contractor John B. McDonald. It is expected also that there will be distinguished speakers from outside the city, including, possibly, President Roosevelt and Governor Odell, who will be invited. Among the guests will by the Mayors of all the principal American cities.

THE NEW SWEDISH ELECTRIC FURNACE PLANT FOR THE MANUFACTURE OF STEEL.

BY FRANK C. PERKINS.

A large number of engineers and inventors in America as well as in Europe have been working energetically upon the problem of the manufacture of high grade steel using electrical power in specially constructed electric furnaces. Considerable progress has been made in this work, and a number of electric furnaces have been constructed and are now in operation producing steel of a very fine quality. By the use of water power, the cost of steel production of the high grade qualities turned out compare very favorably with the cost of other methods. The electric steel furnace seems to occupy a field entirely its own and there seems little question but that it will be employed quite extensively under special conditions in the future.

The accompanying illustration, Fig. 1, shows the electric power house and iron and steel plant at Gysinge, Sweden, where electric furnaces are made use of for the production of steel of excellent quality. An interior view of the power house is shown in Fig. 2

The electric furnaces installed at Gysinge are those designed by Mr. F. A. Kjellin, the furnace last constructed holding 1,880 kilograms, and when charged with cold raw material is capable of producing 1,500 tons per year. The new furnace is supplied with current from a large single-phase alternating current generator recently installed in the power plant and operated by a vertical turbine, which works under a head of only three meters or about 10 feet. This turbine has a speed of 75 revolutions per minute and develops 300 hp. It is directly coupled to a vertical shaft alternator which generates a monophase current at a pressure of 3,000 volts.

Figs. 3 and 4 are views of the interior electric furnace room, the former showing the side of the electric furnace at the time of drawing off the liquid steel, while the latter shows the top of the Kjellin electric steel furnace where the charging of the raw materials is about to be undertaken.

It is held by F. A. Kjellin that in resistance furnaces with electrodes the steel very easily takes up the impurities from the electrodes consumed, and the cost of the electrodes increases the expense of the output, while the carbonic oxide resulting from the oxidation of the electrodes has a very bad influence by preventing the steel from giving off the carbonic oxide dissolved in it.

The steel can be more uniformly heated by passing an electric current of many amperes through the steel and using the heat evolved by the resistance of the steel for smelting. Mr. Kjellin states that as the resistance of the metals when molten is comparatively low, the currents used must be so great that the copper cables have a section at least as great as that of the steel in the furnace. The Swedish inventor, De Laval, tried to avoid these difficulties by using molten slag instead of steel as resistance in his furnace, but it is thought the result was not satisfactory.

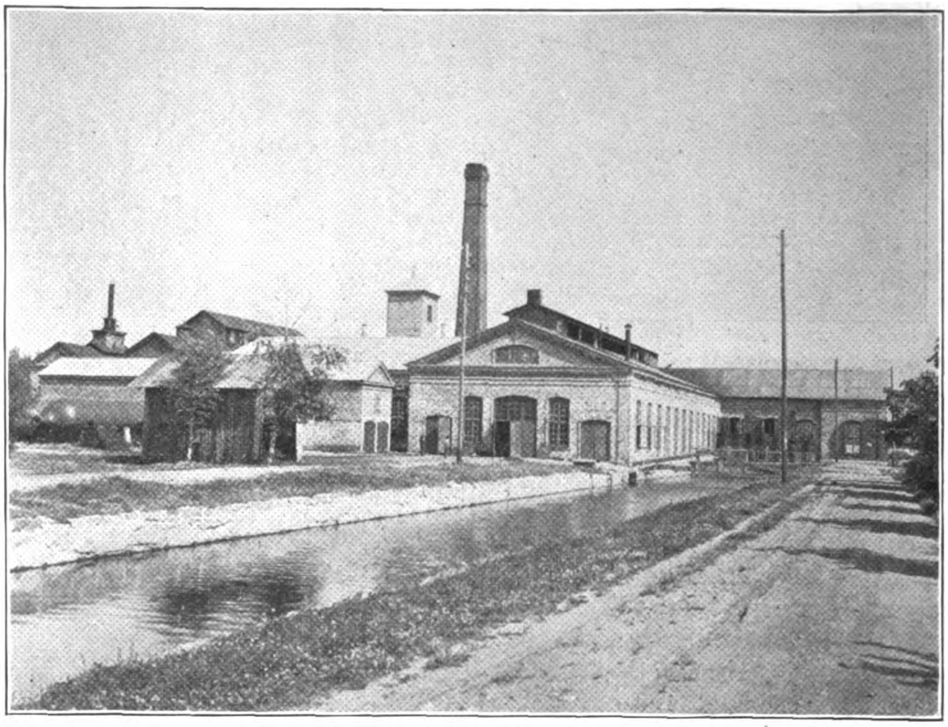

Fig. 1.—Gysinge Plant, Sweden, Operating Kjellin's Electric Steel Furnace.

As the carbon electrodes in furnaces of this kind have high resistance, great losses of tension and power result. Water cooled iron electrodes might be used, possibly, but then the magnetic properties of the iron cause new difficulties to arise.

In order to get sufficient intensity of current alternating currents must be used and then the magnetism causes the concentration of the current at the surface of the electrodes (skin effect) and the result is a great loss of power. On account of self-induction the capacity of the electric generator is also diminished.

In May 1899, in Stockholm, Mr. Kjellin proposed to Mr. Benedicks, general manager of the Gysinge Works, to eliminate these difficulties by constructing an electric furnace without electrodes. This was accepted and the furnaces were built, as shown in Figs. 3 and 4.

The groove forms the furnace chamber, the sides and bottom of which consist of refractory bricks, and covers are used to close the furnace. A quadrangular iron core, formed of thin insulated sheets of soft iron, is in the center of the circle formed by the furnace chamber and this is inclosed by a coil of insulated copper wire. The core continues outside the furnace and forms with the furnace chamber the two links of the chain. An alternator is connected with the coil and the current when passing through the coil excites a varying magnetic flux in the core and this flux induces an alternating electric current in the contents of the furnace chamber.

The operation is, in fact, similar to a step-down transformer having a large number of primary turns and a single secondary turn. The steel in the furnace forms only a single turn around the core, and the current in the steel is then equal to about the primary current in amperes multiplied by the number of turns of wire in the primary coil. The voltage of the current in the steel is of course reduced in the same ratio as the number of amperes are increased. It will thus be seen that it is possible in this way to use an alternating current generator of high tension and yet no transformers are necessary nor copper cables of large sections. The costly and uneconomical carbon electrodes are also avoided, and yet a heavy current is obtained in the furnace with a low voltage.

The first furnace was installed at Gysinge, in February, 1900, and the first ingot was cast on the 18th of March, while it is stated that steel of an excellent

quality was produced from the beginning. This solved the problem from a technical point of view but not from a commercial standpoint, for which an electric generator of 78 kw. capacity it took 24 hours to produce 270 kg. of steel. In November of the same year another furnace was constructed which was able to produce from 600 to 700 kgs. of steel in 24 hours with 58 kw., the charges being 100 kg. every three or four hours. On account of the cooling surface of the walls being too great in comparison to the contents of the furnace the output was not satisfactory and the cost of repairs was too high. In August, 1901, a fire destroyed the sulphite pulp mill at Gysinge, Mr. Kjellin states, and then, instead of rebuilding the same, the water power was utilized for steel making by electric smelting and a new plant was constructed for this purpose. This electric steel furnace plant was started in 1902, and since May of that year has worked extremely well. The furnace shown in the illustrations contained 1,800 kg. of steel, 1,000 kg. being drawn off at a time, the remainder being left to keep the current flowing. It produces 4,100 kg. of steel ingots in 24 hours when charged with cold materials with 165 kw. or 225 electrical horse power.

A single-phase alternating current generator is employed which generates a current of 3,000 volts pressure. This single-phase alternating current is transformed by means of the primary coil and iron core of the furnace into a current of about 30,000 amperes in the steel that forms the secondary circuit.

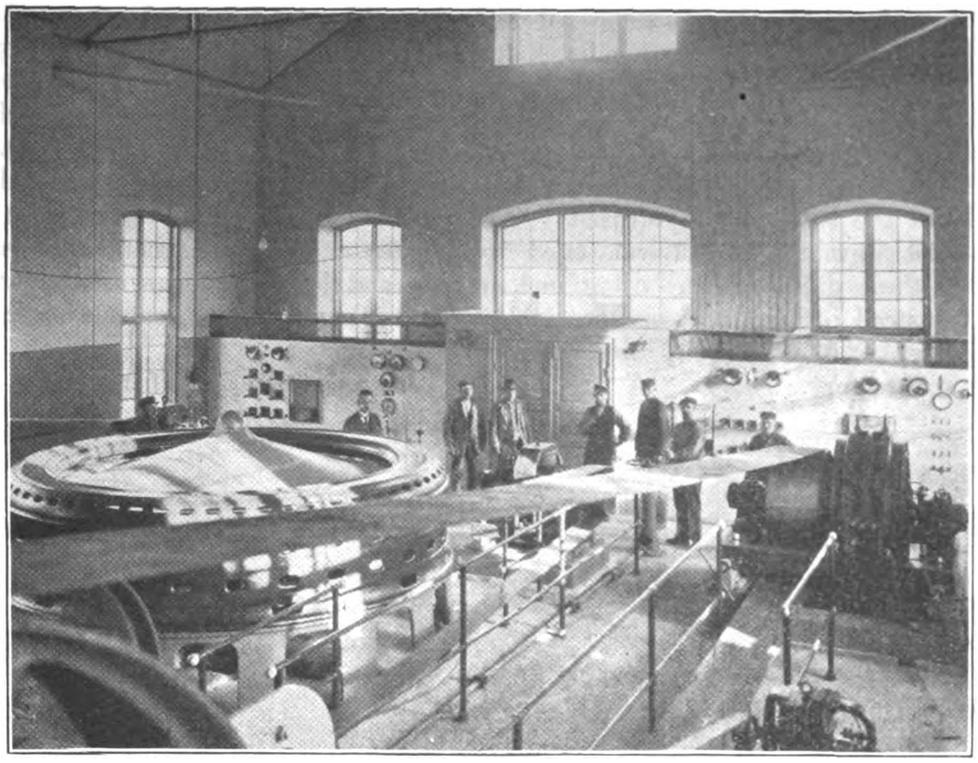

Fig. 2.—3,000 Volt Vertical Single-Phase Generator at Gysinge, Sweden.

At Gysinge there is produced only first-class steel from excellent Dannemore pig iron and wrought iron. The method of operation is as follows: When the steel has been drawn off and about 800 kg. left to keep the current flowing, the furnace is charged with pig iron and bar ends as well as steel scrap in such proportions as the experience has proved will give the percentage of carbon wanted. The resulting steel always has less carbon than the material charged, as the pig iron is usually more or less rusty. When the charge has melted and overheated to a proper degree the metal is drawn off by tapping in the same way as at the open hearth furnace by a hole in the wall of the furnace.

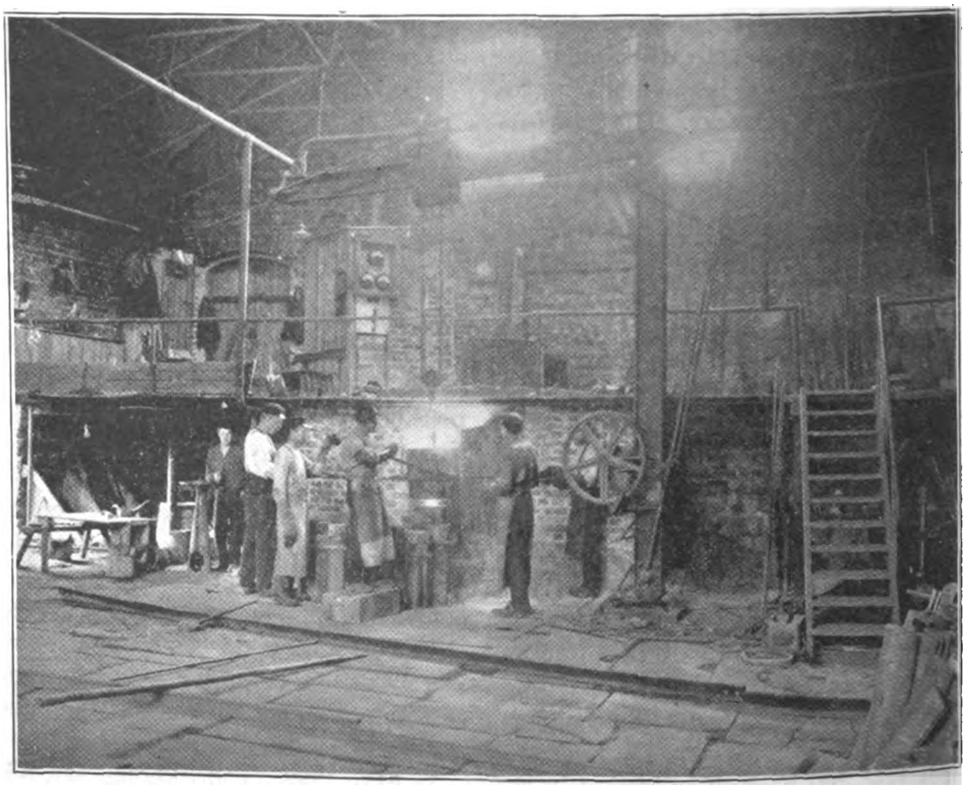

Fig. 3.—Kjellin Electric Iron and Steel Furnace.

As will be noted by the illustrations, the upper part of the Kjellin electric steel furnace is on the same level as the working floor, and the charging is accomplished by simply taking off the covers and putting in the material. As the heat is produced in the steel itself the slag is not so hot as in other steel furnaces, and so the workmen do not suffer from the heat to the same degree.

It is stated that the steel produced is of an uncommonly dense and excellent quality, being homogeneous and unusually tough. It may be easily worked cold when annealed, and is not disposed to crack or warp at hardening as with other kinds of steel. Mr. Kjellin thinks the reason of this is that the steel contains less gaseous matter than other steel, as even small quantities of gases, especially hydrogen, are harmful. He has the following to say in reference to the avoidance of gases in the Kjellin furnace and as to the cost of production of steel ingots:

" By the electric furnace described the steel has no opportunity of taking up such gases or other impurities, and the quality is also better than that of crucible steel with the same analysis. To make special steels with nickel tungsten or chromium offers no difficulties and the alloys are quite homogeneous. The cost

of production depends principally on the efficiency of the furnace and the price of power.

"At the furnace now in use at Gysinge the losses have been experimently proved to be 87.5 kw., so that the effective power absorbed by the steel is 165 — 87.5 = 77.5 kw. and as these produced 4,100 kg. of steel in 24 hours one effective kilowatt produces about 53 kg. steel ingots in the same time. Every kilowatt more in the furnace when the size is not altered increases then the output with 53 kg. steel ingots and we calculate, when we within a few months get a stronger water-wheel, to produce about 6,000 kg. of steel ingots with 200 kw. in 24 hours. As the absolute cost of labor and repair will be the same these costs for one ton of steel ingots will be about two-thirds of the cost now, and the price of power per ton will also be sensibly diminished.

"The cost of repair, that is, of renewing the lining of the furnace of 763 kw. or 1,000 electric hp. will produce 30,000 kg. of steel ingots in 24 hours when charged with cold materials. With hot materials the output is much greater. For instance, if 250 kg. of molten pig iron are charged for each ton of steel ingot produced, the output is increased from 30,000 to 36,000 kg. in 24 hours with electric horse power.

"The cost of labor and repair for such a furnace will in my opinion be less than those of an open hearth furnace of the same size, so that, where power is cheap, there is a possibility of producing a steel competing with the dear crucible steel at a smelting cost not exceeding that of the open hearth furnace."

An estimate of the total cost of producing the steel by the electric furnace is estimated at $42.89, assuming 165 kw. for 4,100 kg. of steel in 24 hours. The cost of one horse power hour being assumed at .375 cent would make the cost of power $5, the wages being $2.50 and the cost of the charge $32.50. The depreciation at interest is estimated at 56 cents, and the cost of repairs and brickwork $2.08, while the cost of the mould is taken as 25 cents. The cost of the charge would be considerably higher if chromium and other expensive material were added, the above estimate of charge being the cost for soft iron and pure charcoal and pig iron. A lining of silica or magnesia stone may be used in this process as the fire gases do not come into contact with the steel even by diffusion. An analysis of one grade of steel made at Gysinge shows a composition of sulphur .01 per cent., phosphorous .011 per cent., with .49 per cent. of manganese and .47 per cent. of silicon, the carbon being represented by 1.45 per cent. The cost of building the electric furnace is given as 1,500 Swedish crowns and it has a capacity of about one ton, the ordinary steel crucibles are usually employed holding about 40 kg. of metal.

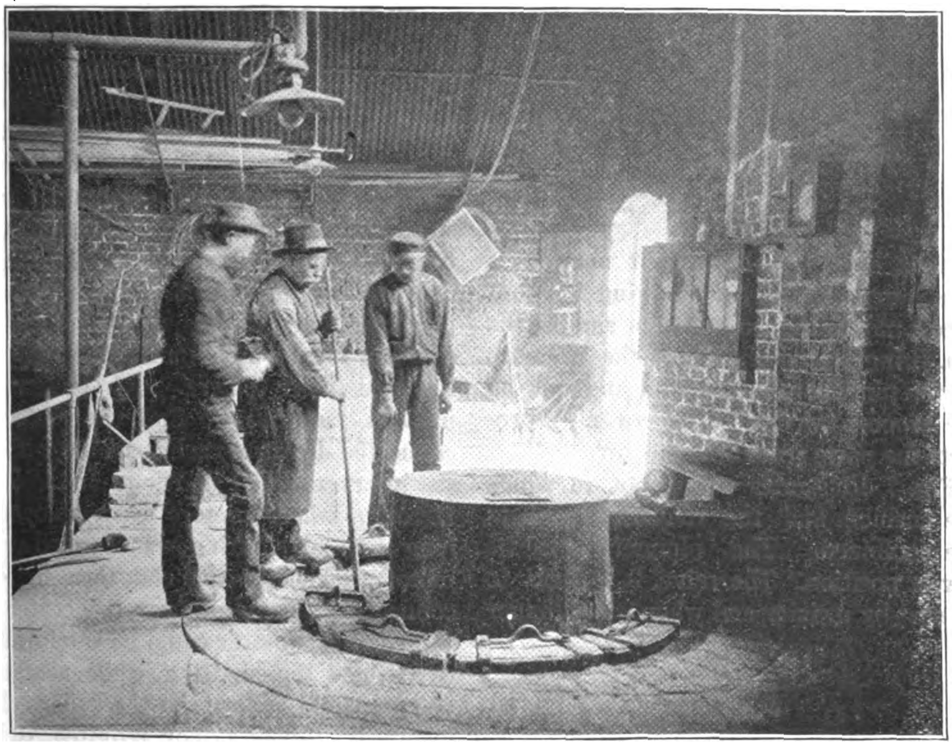

Fig. 4.—Kjellin Electric Iron and Steel Furnace.

Electric Light Statistics.

The United States has 18,000,000 incandescent and 385,000 arc lamps in operation.

DASH POTS FOR CORLISS ENGINES.

ARTICLE III.

BY W. H. WAKEMAN.

Fig. 5 illustrates another kind of dash pot, from which excellent results in practice are secured, because it can be adjusted very accurately. The plunger is made in two parts, one of which is larger than the other, similar to others already described. Air is trapped under the larger part to form a cushion, but its action is such that it may properly be called a compound cushioning device. The plunger is in its lowest position now, but suppose that it is raised until the top of plunger, 2, is level with the top of cylinder, 3. The cut off valve is now tripped, and the plunger begins to descend, causing air to rush through the passage, 4, into the pipe, and thence to the atmosphere.

As the air cannot escape instantly, cushioning is begun before the plunger passes the lower part of this passage, marked 6 in the illustration, but after it passes this point no air can escape except what goes out through the small passage below 4, and this is partially or wholly closed by adjusting the screw, 7, which may be turned at pleasure to give compression enough to prevent pounding. Air from this small passage is also discharged into the pipe, 5, and is conveyed beneath the floor where the noise it makes in escaping is not objectionable. Packing made of leather is placed under this plunger to prevent the two iron surfaces from coming together when the lowest position is reached.

The lower part of this plunger is packed with leather at 8 to assist in preventing air under pressure from passing out of the cushion chamber into the vacuum chamber, 9. A valve, 10, opens outward from this chamber, and is held in place by the spring, 11. The object of this valve is to permit air that finds its way into the vacuum chamber to escape out of the passage 12, and its operation is as follows: When the vacuum plunger rises it draws the valve, 10, to its seat and maintains a partial vacuum in the chamber, but as soon as the plunger descends it compresses air that may have leaked into this chamber, and the pressure so created opens the valve, 10, against the spring, 11, and air goes out of 12.

On a Corliss engine that I had charge of several years ago the vacuum plunger was so large and the vacuum so nearly perfect that it was difficult to provide cushion enough to insure quiet operation without causing the plunger to rebound,

which was not satisfactory. To overcome this objection, a hole was bored through the valve, 10, and a copper pin fitted into it. A flat spot was filed on this pin by means of which a small inlet for air was provided. This plan is better than to file the valve, because the small hole can easily be plugged if it is not wanted, while the valve would be spoiled if it was filed. In this case it resulted in reducing the objectionable noise.

In Fig. 5 the rod is fastened to the plunger by pin, 13, without means for taking out lost motion.

Fig. 6 illustrates a dash pot in which the cushioning chamber, 2, is below the vacuum chamber 3. As the plunger is in its lowest position, neither of these chambers show plainly, but consideration of the cut will make the matter plain. As the plunger rises, air rushes through the inlet, 4, and fills the chamber, 2.

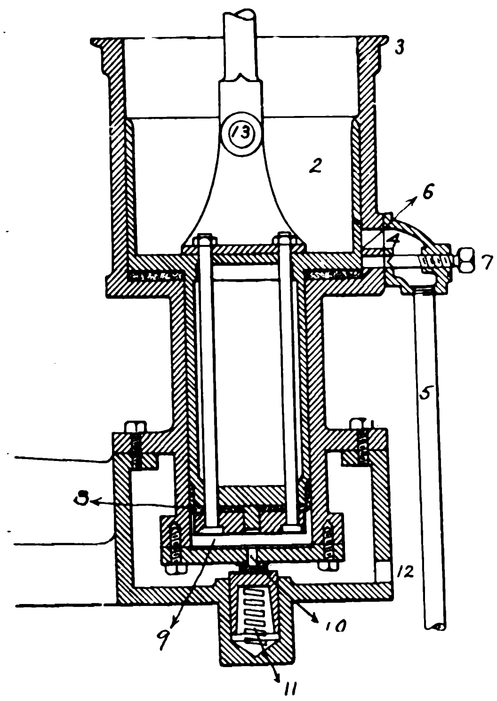

FIG. 5.

when the plunger descends it drives out this air, but the engineer can adjust the screw, 5, so as to throttle it, and thus make a cushion for the plunger.

The leather packing 6 is fixed on the stationary post which forms a central guide for the plunger, and prevents air from passing rapidly into the vacuum chamber, 3.

When the plunger rises it draws the valve, 7, to its seat, but when action is reversed, air that may have entered the chamber, 3, is compressed and opening the valve, 7, against the spring, 8, passes into the open part, 9.

The rod (not shown in the cut), is fastened to the plunger by means of the pin, 10, passing through ears cast on the top of the plunger. This pin is a tight fit in the ears, but loose in the rod, as it must be free to move in two directions. As time passes the pin becomes worn at this point, and as the engine builder has not provided a way for taking up this lost motion, engineers sometimes drive in a wooden wedge, as shown at 11. While

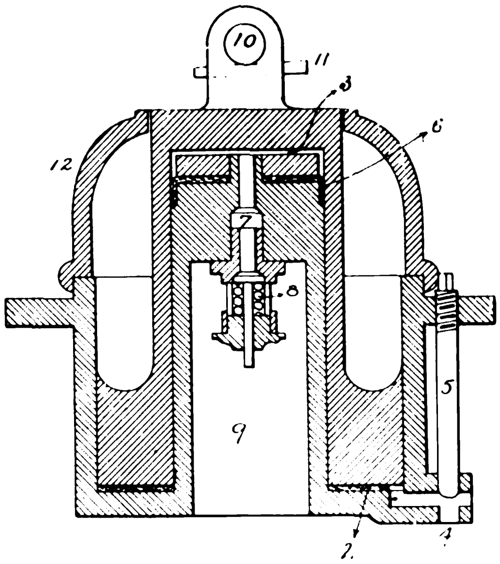

FIG. 6.

this is only a makeshift, it answers a good purpose, for by renewing it about once a month the rod is kept against the pin, bringing nearly all of the pressure on the pin where it belongs, and not on the wooden wedge. The cover 12 protects the parts from dust and dirt.

Fig. 7 illustrates a dash pot in which the cushion and the vacuum chambers are combined. The plunger is in its lowest position. The valve, 2, is held to its seat by gravity and when the plunger

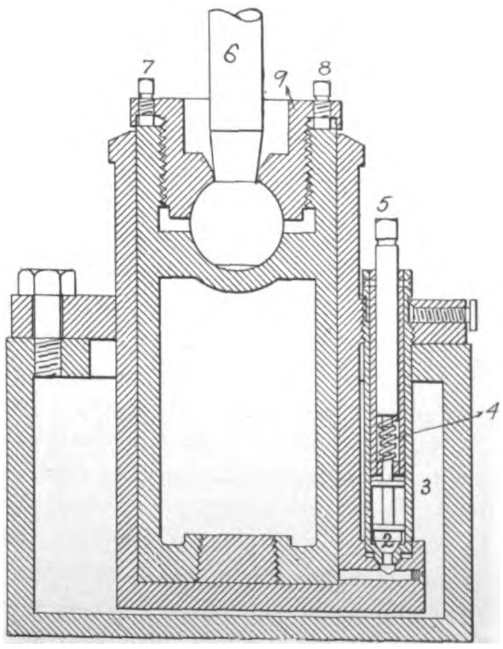

FIG. 7.

is drawn upward this valve is forced downward by external air pressure acting on the top of it.

This insures a partial vacuum under the plunger, and allows air to press upon the top of it effectually, as already explained. When the plunger descends it compresses whatever air may be found in this chamber, thus cushioning the plunger, lifting the valve, 2, and forces air out into the passage 3. This action is opposed by the spring, 4, the tension of which is regulated by the screw, 5.

The dash pot rod, 6, terminates in a ball and socket joint, provided with a very ingenious device for taking out lost motion due to wear. The check screws, 7 and 8, are loosened, and the nut, 9, is turned down until it touches the ball, but does not bind it. The check screws are then tightened holding the adjusting nut in place, and the job is done.

ELECTRIC-DRIVEN PLANTS.

BY WILLIAM KAVANAGH.

Now that the application of the electric motor for power purposes is well understood every practical engineer should endeavor to obtain all the information possible upon the motor and its application to general machinery. When the motor first became prominent as a means of power delivery it was usually belted to shafting from which individual machines received their power. At present in modern factories we find the motor is connected direct to each machine without the intervention of shafting. In the older factories where motors are employed a long line of shafting was erected and a motor attached to each end, then by disconnecting a coupling near the center of the shaft one motor could be employed to drive half the shafting, while necessary repairs could be made to the other. For instance, suppose a floor required 70 hp. then two 35 hp. motors would be employed. This method of driving the shaft is being rapidly superseded by attaching the motor direct to each machine. While the individual application of motors subdivides the power it involves a greater amount of labor on the part of the electrician. Controllers, starting boxes, switches, fuses, etc., multiply and require constant supervision. The old style of delivering power is becoming less every day, the ponderous flywheel and belt has disappeared, the motor and direct connected generator having taken its place.

Instead of the large flywheel and belt we have the direct-connected unit so arranged that the distribution of electricity for different purposes is accomplished without involving any expensive arrangement of shafting mules or belts. The generator in general use for power in medium sized plants is multipolar and of the type known as "constant potential,"

that is, the current varies, but the pressure remains nearly constant under varying conditions. If the current varies, say 100 amperes, the pressure or voltage may not vary over five volts. Such generators usually carry a pressure of either 220 or 250 volts, and in some cases current for heating and incandescent and arc lighting is taken from them. When current for incandescent lighting is taken from the power generator fluctuations will occur in the lamps, making it unpleasant for persons who are in need of steady light. The fluctuations are more pronounced at the moment a heavy load is thrown on or off the generator. In order to obviate these fluctuations some plants are equipped with an independent lighting system. The installation of an independent lighting plant increases the first cost to a considerable degree. In order to lessen this expense some plants are equipped with what is known as the "balancing set," which partially accomplishes the desired result. Where a balancing set is employed, the three-wire system is utilized for lighting and heating purposes, while the two-wire is used for power. The current for operating the balancing set is taken from the main bus bars by means of a two-pole switch, which in turn is connected to a starting-box, the current is carried from the starting-box to the balancing set, which puts it in operation. The balancing set might be called a twin motor having the series windings of its fields connected to the middle bus bar through the medium of a single pole switch. To start the balancing set build up voltage and close the main switch; now close the two-pole switch that is connected to the starting box and cut out resistance; immediately the balancing set will begin to rotate. When all resistance of starting box is cut out close single pole switch. Our lighting system is now ready for use and the current will be balanced from one side of the three-wire system to the other side, according as the demand for current arises on either side. Unless the demand for current is very great and fluctuating at the same time we will obtain a steady light while the balancing set is in operation. Where such a set is employed we are enabled to use either 125 or 250 volts, assuming our generator carries 250 volts. By connecting from the middle wire to either of the outside wires we obtain 125 volts; if we connect to the two outside wires direct we will get 250 volts. It appears that when the balancing set is not in operation we must pull or open all of the lighting switches; we may then run with our power switches closed. Should we leave any of our lighting switches closed when the balancing set is stopped our lamps will surely be burned out. Should any attempt be made to light them in all probability the insulation on our light wires and flexible cord will be destroyed. Where a balancing set is used our power switches will be two-pole and our lighting switches three-pole. Our switchboard will be equipped with four measuring instruments as follows: One voltmeter, one balancing meter that indicates which side of the system is carrying the most current, one main ammeter that registers the total amount of current generated, and one ammeter that indicates the amount of current used for power. Should we wish to calculate the power distributed from such a board it will be necessary to read the amount of current indicated on the two ammeters. Suppose our main ammeter registers 500 amperes and our power ammeter 300, then the electrical horse power will be

$$\frac{(300 \times 250) + (200 \times 125)}{746}$$

instead of $\frac{500 \times 250}{746}$, because we are sending out on the power line 300 amperes at a pressure of 250 volts, and on the lighting and heating lines 200 amperes under a pressure of 125 volts. Some engineers make the mistake in multiplying the amperes indicated on the main ammeter by 250, which is not correct. Others take the sum of the amperes, which is also wrong. Let us take the above case. We see that the result would read $\frac{800 \times 250}{746}$, which would equal 268 hp., whereas the correct answer is 134.04 hp.

ELECTRICAL STATION PRACTICE.

ARTICLE XXVIII.

BY W. H. RADCLIFFE.

The starting, stopping, and general operation of rotary converters form an important part in the routine of many sub-stations. As to the starting of these machines for the purpose of converting alternating current into direct current, any one of several methods may be employed, the choice in any given case depending upon which of them may best be followed under the existing conditions.

If it is found advisable to start the converter with direct current, the same connections would be made between the source of the direct current and the armature terminals on the commutator side of the converter as would be the case were a direct current shunt motor of considerable size to be started; this naturally means that a starting rheostat and a circuit breaker will be introduced in circuit. The shunt field winding alone is used, and this part of the winding may be made permanent if, as is usually the case, the same source of direct current is used normally for separate field excitation. The direct current may be derived from a storage battery, from a separate converter, or from a motor-generator set installed in the sub-station for the purpose. An adjustable rheostat will, of course, be connected in the field circuit for regulation. Before starting the converter, however, it is necessary to do certain wiring between the terminals on the collector side of the machine and the alternating current supply wires, in order that the change-over from direct current motive power to alternating current motive power may be made when the proper phase relations are established between the alternating current in the supply wires and the alternating current in the armature winding of the converter.

In order that proper phase relations exist, the armature of the converter must rotate at such a speed that each coil thereon passes its proper reversal point at the same time as the alternating current reverses in the supply wires. This speed may be calculated by doubling the frequency of the supply current and then dividing by the number of pole pieces on the converter, but a far more accurate method of judging when the converter is in step or in synchronism with the supply current consists in employing incandescent lamps as shown in Fig. 28.

In this illustration the alternating current side of a three-phase converter is shown at *c*. The three brushes, *d*, *t* and *g* pressing on its collector rings are joined in order to the three single-pole switches *h*, *l* and *b* which can be made to connect with the respective wires *m*, *r*, and *v*, of the supply circuit. Across one of the outside switches, *h*, for example, a number of incandescent lamps are joined in series as indicated at *e*, while the switch (not shown) in the main circuit, is open. If then the main switch just mentioned and the middle switch *l* be both closed, and the armature of the alternator be brought up to normal speed by running it as a direct current motor, the lamps at *e* will light up and darken in rapid succession; the lighting and darkening of the lamps will continue until, by a proper adjustment of the speed, the correct phase relations be established between the current supplied by the alternator and the alternating current in the armature of the

converter. As this condition is approached, the intervals between the successive lighting up and darkening of the lamps will increase until they remain perfectly dark. There is then no difference of potential between the supply circuit *m r v* and the rotary converter armature circuit, so the source of the direct current may at that instant be disconnected from the machine and the switches *h* and *b* closed. If the change-over has been affected before the phase relations of the two circuits differed, the converter will at once conform itself to the alternator circuit and run thereon as a synchronous motor without further trouble. The opening of the direct current circuit and the closing of the alternating current circuit may be done by hand, but preferably by employing a device that will automatically trip the circuit breaker in the direct current circuit at the instant the switches in the alternating current circuit are closed.

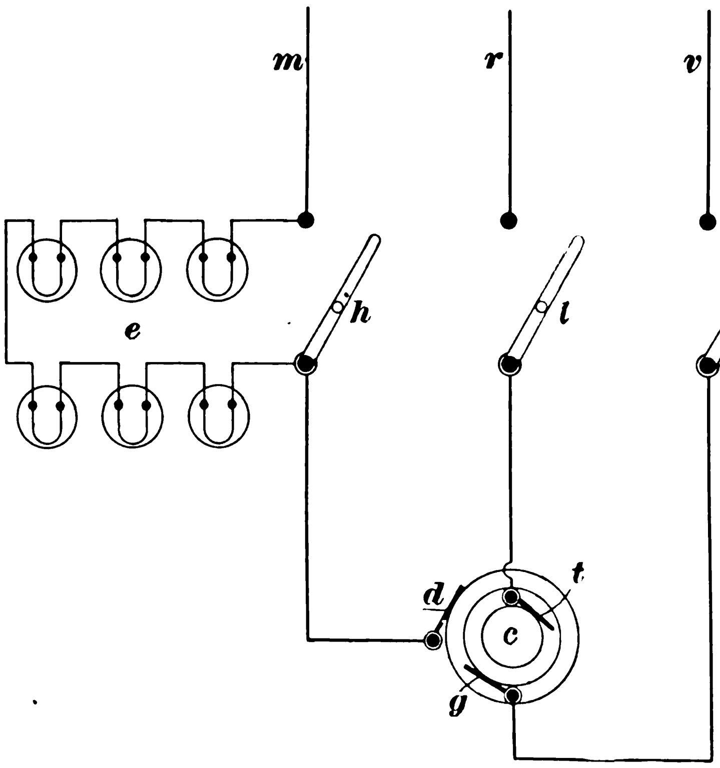

FIG. 28.

If the rotary converter be of the polyphase type and it be desired to start the machine with alternating current, this may be done by applying the alternating electromotive force directly to the collector rings while the armature is at rest. There need be no field excitation; in fact the field windings on the separate pole pieces should be disconnected from each other before the alternating electromotive force is applied to the armature, else a high voltage will be induced in the field windings which may prove injurious to their insulation. The passage of the alternating current through the armature winding produces a magnetic field which rotates about the armature core and induces in the pole pieces eddy currents, which reacting on the armature exert a sufficient torque to start the converter from rest and cause it to speed up to synchronism. The alternating current required to start the converter in this way greatly exceeds its normal full load value, sometimes to an extent of 100 per cent. To reduce this starting current, transformers may be switched in circuit temporarily to reduce the line wire voltage until the speed has become normal.

A convenient means is afforded, when starting the converter by this method, for ascertaining when the converter is running in synchronism with the alternator supplying it, and when therefore the field circuit may be closed and the load thrown on. Reference is here made to the connection of incandescent lamps across the brushes pressing on the commutator, or across the leads connected therewith. In starting, there is an alternating current between the brushes which pulsates very rapidly, but when synchronism is approached the pulsations become less rapid until finally with the converter in step with the alternator the pulsations entirely disappear. The light given by the lamps connected, as previously stated, indicates accurately the condition of affairs at any one time, varying from a rapidly fluctuating light at the beginning to one of constant brilliancy when synchronism is attained.

The most modern method of starting rotary converters is to mount on an iron bracket cast in with the converter frame, a small induction motor of the polyphase type whose armature shaft is keyed to that of the converter. The bracket, and therefore the motor, is usually mounted outside the armature bearing on the collector side of the converter. Allowing for a certain amount of slip in the induction motor, the field of this machine must possess a less number of magnet poles than the converter in order to enable the latter machine being brought to full synchronism. To start the induction motor it is simply necessary to apply to its field terminals the proper alternating electromotive force. If its armature is provided with a starting resistance to reduce the current at the beginning, this resistance must be in series with the armature conductors before the alternating electromotive force is applied. As the motor increases in speed, the starting resistance is gradually short-circuited until it is entirely cut out of circuit. In all standard types of induction motors the starting resistance is mounted within the armature spider and is adjusted by means of a handle which may be moved in or out while the armature is rotating.

The usual wiring for the installation of a rotary converter in a sub-station commencing at the entrance of the high pressure cables is first that for the lightning arresters, then for the connection in circuit of the high tension switching devices, from which the conductors are led to bus bars, and thence to the step-down transformers. On a three-phase system the transformers should be joined in delta connection, as thereby a considerable advantage is gained over the star connection, in that should one of the transformers become defective the remaining two will carry the load without change except more or less additional heating. Between the transformers and rotary converter the circuits should be as short and as simple as possible, switches, fuses, and other instruments being entirely excluded. The direct current from the converter is led to the direct current switchboard, and from there is distributed to the feeder circuits.

In large sub-stations where several rotary converters are in operation they may often be found receiving their respective currents from the same set of bus bars; that is, they may be operated as alternating current motors in parallel. They are also, however, frequently operated independently from single bus bars, but very seldom in series with each other. The direct current circuits of several converters may, if desired, be connected together in multiple and give satisfactory results. As in central station practice, provision should be made against inter-

ruption of service from the sub-station by providing therein one reserve rotary converter to every three or four converters actually required.

A rotary converter in operation generally produces more satisfactory results and requires even less attention than does a direct current generator delivering the same output. The reasons for this are, there is less friction loss; there is less armature resistance, since the alternating current at certain portions of each revolution passes directly to the commutator bars without traversing the entire armature winding as it must necessarily do in a generator; there is no distortion of the field and consequently no sparking, or shifting of the brushes, since the armature reaction resulting from the current fed into the machine and that due to the current generated in the armature completely neutralizes each other.

There are, however, certain detrimental features characteristic of rotary converters that should not be overlooked. Of these may be mentioned that of voltage regulation. The direct current voltage developed can be maintained constant only by preserving uniform conditions of inductance in the alternating current circuit, and uniform conditions in the alternator. While changes in either of these may be compensated to a certain extent by adjustment of the field strength of the converter, they cannot be entirely neutralized in this manner; it is therefore necessary that both the line circuit and the alternator be given attention if the best results are to be obtained from the converter.

Another detrimental feature of the rotary converter is that it possesses a tendency to run at varying speeds regardless of the impressed voltage; this is caused by a variation in frequency and is known as hunting. Whereas the inertia of the converter armature tends to maintain a constant speed, variations in the frequency of the supply circuit will cause a displacement of phase between the current in the armature and that in the line wires, which displacement, however, the synchronizing current strives to decrease. The synchronizing current, although beneficial in remedying the trouble after it occurs, exerts but little effort in preventing it, and many minds have spent many hours in many ways striving to devise some plan whereby this trouble might be eliminated. Of the methods in use at the present time for the prevention of hunting there are the employment of a strongly magnetized field relatively to that developed by the armature, a heavy flywheel effect in the converter, increasing the inductance of the armature by sinking the windings thereon in deep slots in the core which slots are provided with extended heads, and the employment of damping devices on the pole pieces of the converter.

It is generally admitted that the damping method has proved to be the most effectual remedy for hunting. The devices employed for the purpose are generally copper shields placed between or around the pole pieces, although in some converters the copper is embedded in the poles, and in others it is made simply to surround a portion of the pole tips. In any case its action is as follows: The armature rotating at a variable speed has a field developed therein which is assumed to be also rotating at a variable speed; the magnetism of this rotary field induces currents in the copper which, however, react on the armature and oppose any tendency toward a further shifting of the magnetism in the armature and therefore prevent the development of additional currents in the copper. Since copper is of low resistance, the induced currents are sufficient in strength to thus dampen any tendency toward phase displacement and so exert a steadying influence upon the installation as a whole.

Although rotary converters, as has just been shown, are not without objectionable features, they may at the same time be said to constitute the most practical and efficient machines that can be installed in a sub-station for the conversion of alternating currents from the transmission line into direct currents for distribution.

PRESENT INDEPENDENT TELEPHONE SITUATION.*

BY J. B. WARE.

This State Association was one of the first to be formed and was organized in 1897, seven years ago.

While several States claim to be the birthplace of the Independent movement, Michigan seems to have as good ground for such claim as any. Whatever difference there may be as to the birthplace, I feel confident that few, if any, acquainted with the history of the movement, will question our right to claim Michigan as the home of this enterprise in its childhood days, and that its present proportions are largely the outgrowth of the early start and the strength which it obtained on Michigan soil. Not alone was one of the first opposition exchanges built in our State, but Michigan was the first to have an Independent exchange in operation, numbering 500 telephones; also the first to have 1,000, also 2,000 and 5,000; also the first to have an automatic exchange with 500 telephones in service; also the the first in which an opposition company put up copper metallic toll circuits. I regret to recall to your attention that our State was also the first having in it men who planned to succeed as Independents, and then betray the movement, by sale, to the Bell interest, and that these men so nearly succeeded in their treacherous attempt, as to cause in the minds of many, even to this day, suspicion to rest on telephone men in general, as their honesty and uprightness.

Thus we have in our State's telephone history, and within the short space of seven years, the two extremes of honorable and dishonorable record; but, as must always be true, honesty does pay, and success has crowned the honest effort.

In addition to the record already mentioned, we have, in common with many other States, the satisfaction of having seen the Independent movement a constantly increasing success year by year, until to-day there are in the United States, more Independent telephones in use, than there are Bell telephones by exchange subscribers; and that as a rule, those using Independent are receiving much better exchange service than are those using Bell instruments; and, further, the Independent companies have proven financially successful, with exceedingly few exceptions.

Until about 1895, the Bell interests had no competition in the telephone field, and there were no successful opposition companies previous to eight years ago.

It is not my purpose to review the history of the Independent movement, but to mention briefly a few facts and figures which indicate, though inadequately, the present condition of the movement in different sections of our country.

The Independent telephone development has been most rapid and successful in the Middle and Central Western States where it started, and is most retarded in the extreme Eastern States.

Thus in the six New England States, a very populous section of our country, there are fewer Independent telephones in service than in each of more than 20 other States in the Union.

The reason for this condition is generally and rightfully understood as being, principally, because of the political influence of the Bell Company in the territory named, which, united with that of the Boston & Hartford Railroad interests, apparently have absolute control of legis-

* Paper read at the annual convention of the Michigan Independent Telephone Association held in Detroit, Feb. 25, 1904.

lation in the majority of these States. The difficulties in securing franchises for opposition telephone plants, are almost insurmountable, and are greater than in any other section of our country.

Another factor, however, not generally understood, has bearing on the situation named, being the restrictions placed on the use of the automatic apparatus, under Strowger patent, by reason of the heavy royalty charged in certain of these States.

The automatic apparatus named first secured a foothold in these Eastern States, over the most of which the Eastern Automatic Telephone Company secured exclusive rights to use apparatus manufactured under said patents. This company, having its headquarters in Boston, the home of the Bell Company, followed the ruinous Bell policy of charging such a heavy royalty on each telephone used as to almost prevent the use of the automatic apparatus in the States named. While this same condition formerly existed in other sections of the country, fortunately for the Independents, the Strowger patents are now owned and controlled by the Automatic Electric Company of Chicago. This company, like all other Independent telephone manufacturing corporations, sells outright its apparatus and telephones, upon which there is no royalty. It has secured the State rights of all such companies, other than the Eastern Automatic, and is endeavoring to obtain such rights from that company, in order that there may be no royalty burden in the Independent field. It is to be hoped that it may succeed in removing this unfortunate and unreasonable burden from this unfortunate section of our country.

However, in the New England States, valuable development has already taken place; thus in Massachusetts are the Fall River and New Bedford exchanges; in Maine, the Portland exchange. These, with others in smaller cities, give evidence of a splendid telephone development which we may expect in the very near future will be realized in this home territory of the Bell Companies.

In the State of New York, outside of New York City, the Independents have occupied every city and town of importance and operate more telephones than do the several Bell companies occupying that territory. The estimate of the number of Independent telephones in the western half of the State is 45,000, and for the eastern half 30,000, a total of 75,000.

In a majority of cases, the larger exchanges in New York have been built in the last two years, and the greater number of those having 500 or more telephones in operation are the central energy type of exchanges.

The toll line and long distance construction is modern; especially is this true in Western New York, where the poles used are principally 30 ft. cedar, with 8 inch tops, and the copper circuits not smaller than No. 10. No better construction has been made by either Bell or Independent interests in any State.

Of the cities having Independent exchanges in operation, are Buffalo, with 7,000 telephones, and Rochester having over 6,000 telephones; Troy with 4,000; Albany, Utica, Syracuse, Binghamton and Jamestown, averaging 2,500 each; Herkimer, Glens Falls, Saratoga Springs, Schenectady, Rome, Cortland, Ithaca, Elmira, Hornellsville, Geneva, Auburn, Johnstown and Niagara Falls averaging over 1,000 each. The Independents have more telephones in service in these 21 cities named than have the Bell Companies. In four of the cities, the Bell has the larger number of telephones; in 12, the Independents have the larger number, and in the remaining five the numerical strength is equal. In the smaller cities, villages and rural communities throughout the State, without any noticeable exception the Independents have much better development than have the Bell licensees. The conditions to-day, and the outlook, is most favorable to the Independent.

In New Jersey and Pennsylvania all important cities and towns have been occupied by Independent companies; thus, in Philadelphia, there are nearly 12,000 Independent telephones in service; in Pittsburg and Allegheny, over 11,000; in Paterson and Trenton, N. J., and in Scranton, Wilkes Barre, Erie, Harrisburg and other important Pennsylvania cities, the Independent telephones largely exceed those of the Bell. In the smaller cities and towns throughout these two States the Independents have been even more successful than in the larger.

The State of Mayland has been well developed, the Independents in Baltimore having over 8,000 telephones in service previous to the recent fire. The three States of New Jersey, Pennsylvania and Maryland, have good long distance toll line development with Philadelphia as a center. (It is interesting to note at this point that Philadelphia has a toll board of 21 positions, being the largest in the Independent field, with one exception.)

In Virginia and in the Gulf States much progress has been made by the movement during the past two years. Exchanges have been established among the important cities, such as Norfolk, Va.; Columbia and Charleston, S. C.; Jacksonville and Tampa, Fla.; Atlanta, Augusta and Savannah, Ga.; Birmingham and Mobile, Ala.; San Antonio, Waco, Ft. Worth, Houston and Austin, Tex., besides many exchanges in the smaller cities and towns in the States named. While in Florida and others of the States, the development has been rapid, yet in Texas the development has been most remarkable. In this State not a city or town of importance but has an Independent exchange in operation, or one rapidly approaching completion. The character of construction is excellent and the long distance toll lines now building and planned insure for Texas in an exceedingly short time adequate exchange and toll service.

In the States of Tennessee, Kentucky and West Virginia, some very satisfactory development has been made. The cities of Vicksburg and Memphis, Tenn.; Lexington, Louisville and Knoxville, Ky.; Charleston and Wheeling, W. Va., are perhaps the most prominent of the Independent exchanges. These, with numerous other exchanges in the three States, have already secured long distance toll connections with the States to the northward, Ohio and Indiana particularly.

These last two mentioned States are foremost in telephone development. In Indiana, all cities, towns and villages, with hardly an exception, are successfully occupied by the Independents, and fine long distance lines have already been completed; so that, second only to Ohio, its telephone development is the most complete of any in the United States.

In Ohio, the entire State with the single exception of Cincinnati, has been occupied by the Independents with their exchanges and toll lines. So complete has been this development it is unnecessary to enumerate any of the cities occupied.

The relative strength of the two interests, numerically, in the States mentioned is as follows:

	Independents.	Bell.
Ohio..........	145,000	89,000
Indiana........	107,000	40,000
Total........	252,000	129,000

being nearly "two to one."

Besides numerous small exchanges in Minnesota, the cities of St. Paul, Minneapolis and Duluth have large successful exchanges in operation, with more telephones in service than have the Bell Companies in said cities.

(*To be continued.*)

Prof. Owens on Interior Electric Wiring.

Prof. R. B. Owens of McGill University, lecturing before the Insurance Institute of Montreal on "Interior Electric Wiring," gave the three conditions which must be fulfilled to involve the minimum risk to property and life. First, the conductor system must be of such ample current carrying capacity that there would be no overheating of the conductors, which would mean probably fire of some sort. In the second place, the conductor must be so insulated as to render it harmless with regard to shock and also to prevent any leakage of the current, which might cause fire. Third, no conductor system could be considered properly installed unless all the best known current pressure limiting devices were attached to it. There are three systems of interior winding—open cleat, molded and conduit. The last named was the only one that could be relied on with safety. With a properly insulated conduit system, he believed, there would be no chance of danger.

American Institute of Electrical Engineers.

The following papers relating to high-pressure transmission matters are contained in the January number of the "Transactions:"

"The Relative Fire-risk of Oil and Air-blast Transformers," by E. W. Rice, Jr.

"Use of Group-Switches in Large Power Plants," by Louis B. Stillwell.

"Oil Switches for High Pressures," by E. M. Hewlett.

"Terminals and Bushings for High-Pressure Transformers," by Walter S. Moody.

These papers will be discussed at the meeting to be held at 108 West 55th street, New York, March 25.

Examination for Assistant Electrical Engineer.

The United States Civil Service Commission announces an examination April 6-7, to secure eligibles from which to make certification to fill vacancies in the position of assistant electrical engineer in the Signal Service at Large, Washington, D. C., at $1,400 per annum, and other similar vacancies as they may occur. Two days will be required for this examination; age limit, 20 years or over. Applicants for this position should have a good general knowledge of electrical science, and should be thoroughly familiar with telephone, telegraph and cable engineering.

Electrochemical Society General Meeting.

The fifth general meeting of the American Electrochemical Society, will be held at Washington, D. C., April 7, 8 and 9.

The meeting will be held at the Columbian University, corner 15th and H streets, N. W.

Thursday and Friday afternoons will be devoted to visits to scientific laboratories, Government institutions and various points of interest in and about Washington.

On Thursday evening the presidential address will be delivered and will be followed by a complimentary smoker.

Friday evening there will be a subscription banquet at the Shoreham, corner 15th and H streets N. W.

PERSONAL MENTION.

Mr. W. W. Wheatley, formerly with the Public Service Corporation of New Jersey, has been appointed general manager of the City of Mexico electric traction system and has already started for the scene of his new activities, with W. B. Rommel, an electrical expert.

Mr. B. H. Warren, second vice-president of the Westinghouse Electric & Manufacturing Company, has been elected president of the Allis-Chalmers Company, as successor to Charles Allis, who resigned the office a few days ago.

Mr. Robert McCulloch, general manager of the Chicago City Railway, has been elected vice-president and general managar of the St. Louis Transit Company, of which he became a director last week. It is probable that his son will be made superintendent, vice John Grant.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 8, 1904.

Electric Railways and Appliances.

753,839. Trolley-Wire Finder. William Barnhurst, Dallas, Tex. Filed June 1, 1903.

753,925. Electric Railway-Motor. Robert Siegfried, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed May 2, 1903.

753,929. Railway-Brake. Harry A. Spiller, Boston, Mass., assignor, by mesne assignments, to the Algonquin Electric Brake Corporation, same place. Filed May 6, 1903.

754,127. Switch for Overhead Trolley-Tracks. Walter L. Clark, Everett, Mass., assignor to J. Duncan & Co., Boston, Mass. Filed Dec. 24, 1903.

754,214. Traction-Wheel. William E. Harris, Pittsburg, Pa., assignor of one-half to Joseph F. Klapka, Allegheny, Pa. Filed July 18, 1903.

754,359. Apparatus for Stopping Railway-Trains from the Line and for Signaling Purposes. Bernardus A. J. van der Hegge-Zijnen, Hanover, Germany. Filed May 26, 1902.

754,362-754,363. Railway Signaling System. Henry Bezer, Westfield, N. J. Original application filed Oct. 19, 1901. Divided and last application filed Feb. 4, 1903.

Electric Lights and Appliances.

753,935. Incandescent Electric Lamp. Herbert M. Taylor, Hamilton, Can. Filed Sept. 2, 1902.

754,235. Extension-Fixture for Incandescent Electric Lamps. Conrad M. Pitel, Meriden, Conn. Filed May 6, 1903.

754,251. Electric Lamp. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company. Filed March 6, 1903.

Electrical Machinery and Apparatus.

753,866. Brush-Holder for Electrical Machines. William H. Foot, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 24, 1903.

753,872. Electric Printing-Machine. George S. Gallagher, New York City, assignor to himself, Rupert L. Joseph and Frank E. Burrows, same place. Filed April 29, 1903.

753,879. Electromagnet. Willis D. Gregory, Pittsburg, Pa. Filed April 9, 1903.

753,881. Electric Snap-Switch. Gerald W. Hart, West Hartford, Conn., assignor to the Hart Manufacturing Company, Hartford, Conn. Filed April 18, 1903.

753,954. Electric Machine. Niels A. Christensen, Milwaukee, Wis. Filed May 8, 1901.

754,123. Insulator-Pin. James H. Bullard, Springfield, Mass. Filed Oct. 26, 1903.

754,124. Electric Motor. David P. Burdon, Jacksonville, Fla., assignor of two-thirds to Samuel P. Holmes and Gustave Muller, same place. Filed July 13, 1903.

754,133. System of Alternating-Current Distribution. Edwin R. Gill, New York City, assignor to the Invention Developing Company. Filed Sept. 5, 1900.

754,291. Magnetic Clutch. Arthur C. Eastwood, Cleveland, O. Filed Jan. 26, 1904.

754,292. Elastic-Fluid Turbine. William L. R. Emmet, Schenectady, N.Y., assignor to the General Electric Company. Filed March 14, 1903.

754,371. Alternating-Current Transformation. Maurice Hutin and Maurice Leblanc, Paris, France, assignors, by mesne assignments, to George Westinghouse, Pittsburg, Pa. Filed April 3, 1895.

754,372. System of Alternating-Current Transformation. Maurice Hutin and Maurice Leblanc, Paris, France, assignors, by mesne assignments, to George Westinghouse, Pittsburg, Pa. Original application filed April 3, 1895. Divided and this application filed Nov. 19, 1903.

754,378-379-380. Electric Switch. Norman Marshall, Newton, Mass., assignor to the Marshall Sanders Company, Boston, Mass. Filed June 27, 1903, and Oct. 6, 1903.

Telephones and Telephone Apparatus.

753,903. Toll Apparatus for Telephone Exchanges. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed May 9, 1902.

753,927. Switching Apparatus for Telephone Exchanges. Edwin H. Smythe, Freeport, Ill., assignor to th Western Electric Company. Filed March 10, 1902.

753,956. Relay. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company. Filed April 1, 1901.

754,011. Commutator for Telephonic or other Circuits. Carl H. Prott, Rheydt, Germany. Filed June 14, 1902.

754,041. Telephone Attachment. Joseph Blum, Baltimore, Md. Filed May 23, 1903.

754,057. Antiseptic Attachment for Telephone Mouthpieces. William M. English and Arthur H. Ten Broeck, San Francisco, Cal. Filed April 1903.

754,211. Telephone or Telegraph System. Thomas W. Gleason, Boston, and Robert Hamilton, Milton, Mass. Filed May 1, 1903.

754,224. Telephone Repeater and System. Samuel P. Levenberg, New York City. Filed April 24, 1903.

Miscellaneous.

753,863. Wireless Signaling. Reginald A. Fessenden, Manteo, N. C., assignor to the National Electric Signaling Company, Pittsburg, Pa. Filed Sept. 28, 1901.

753,864-754,058. Signaling by Electromagnetic Waves. Reginald A. Fessenden, Fortress Monroe, Va., assignor, by direct and mesne assignments, to the National Electric Signaling Company, Pittsburg, Pa. Filed Oct. 1, 1903 and Aug. 8, 1903.

753,875. Electrical Manufacture of Iron Alloys. Gustave Gin, Paris, France. Filed July 7, 1902.

754,018. Electric Sad Iron. George J. Schneider, Detroit, Mich., assignor to the American Electrical Heater Company. Filed Aug. 11, 1903.

754,020. Electric Apparatus for Measuring and Recording Intervals of Time. Calvin J. Springer, Somerville, Mass. Filed June 27, 1903.

754,081. Battery Stopper. Albert Muller, New York City. Filed Oct. 24, 1903.

754,147. Apparatus for Electrical Production of Nitrogen or Other Compounds. Josef von Kowalski and Ignaz Moscicki, Freiburg, Switzerland. Filed Feb. 21, 1903.

754,152. Signaling Apparatus. Otto Luddeckens, Breslau, Germany. Filed Feb. 21, 1903.

754,208. Electric Signal. Joseph E. Feller, Brooklyn, N. Y. Filed April 24, 1902.

754,397. Electric Clock. George S. Tiffany, Brooklyn, N. Y., assignor of one-half to James Van Inwagen, Chicago, Ill. Filed Nov. 30, 1901.

754,402. Fault Locator for Electric Cables. Daniel E. Wiseman, Spokane, Wash. Filed Aug. 3, 1903.

THE TELEPHONE WORLD.

Another Independent Telephone Association Organized.

Representatives of Independent telephone lines of Southwest Missouri, Northwest Arkansas and Northeast Indian Territory lately met at Gravette, Ark., and organized the Tri-State Independent Telephone Association, with officers as follows; President, W. T. Stahl, of Siloam Springs; vice-president, S. H. Slaughter, of Fayetteville; secretary, K. J. Comfort, of Westville; treasurer, W. D. Wasson, of Gentry. The object of the association is the betterment of local and long-distance service. They will also endeavor to devise plans for farmers' lines in their respective territory. Their next meeting will be held at Fayetteville in June.

An application has been made for a charter for the Lake & Lehman Telephone Company. The object of those interested is to construct a telephone line for the accommodation of farmers residing between Dallas and Loyalville, Pa., and later to extend to Sweet Valley. The population of the torritory it is intended to serve is about 10,000, and 50 have already signified a desire to install telephones. Unless something unforeseen occurs the company will begin to place poles and string wires about the first of next month, the promoters being desirous of having the line in operation by June 1. The officers of the company are: President, C. H. Randall, of Loyalville; secretary, William Armstrong of the same place; treasurer, Milton L. Ruggles, of Pike's Creek.

For several months past Wolcott, N. Y., has been enjoying the benefits of a well-equipped telephone exchange without any cost to the patrons of the exchange. Some time ago the Empire Telephone Company established an exchange there with about 80 subscribers, with the understanding they should have its benefits three months free of cost. The time expired March 1, but as the company has recently been reorganized the telephone rates have not yet been fixed and the probabilities are that the free service will continue six or eight weeks longer. There is some prospect of an exchange being established by local parties in case the established rates of the present company should prove too high.

The Chickasaw-Choctaw Telephone Company of Durant, I. T., has purchased the franchise of the Bokchito Telephone Company, and will at once erect an exchange extending the long-distance line east to Bennington, Hugo and Antlers.

The telephone line from Whitesburg, Ky., to Stonega, Va., is nearing completion. When this is done it will put Letcher County in close connection with Louisville and other points in Kentucky.

A new telephone company is being organized at New York Mills, Minn., to establish an exchange in that village and extend lines into the country adjacent.

At the annual meeting of the stockholders of the New York & New Jersey Telephone Company lately the retiring board of directors was re-elected.

Texas Telephone Lines Under One Management.

E. H. Huntington has just closed a deal through Frank C. Smith, whereby he becomes owner of 13 additional Independent telephone exchanges in Texas. The new exchanges just purchased are the Austin, Taylor, Temple, Belton, Sour Lake, Saratoga, Kountz, Woodville, Village, Kirbyville, Coll, Jasper and Bronson, and the long-distance lines of the Commercial and the Lone Star Companies.

The price paid for these, together with the Houston, Galveston, Corsicana, Nacogdoches, San Marcos, Port Arthur and Liberty exchanges previously acquired, exceeds $1,000,000,

Many Rural Telephones in Kansas.

In the last six months more than 3,000 rural telephones have been installed in Kansas. The farmers in most cases organize a company, build their own line and charge each member the actual cost of the line and their part of the operating expense. In this manner it makes the telephone cheap. They connect with each other and also with the long-distance companies, making one large complete system. It is stated by good authority that more than 2,000 telephones will be installed next year.

The Home Telephone Company of South Bend, Ind., has decided to enter Niles, Mich., in competition with the Michigan Bell Telephone Company. The outlook is favorable for a cut-rate war. The newcomers will extend side lines to Buchanan, Galien, Three Oaks and Cassopolis, supplying service to intervening territory.

The Central Telephone Company of Nebraska, a concern organized to combine the Independent telephone companies of that State, has incorporated two new telephone exchanges, one at Loup and one at Ravenna. Articles of both exchanges were lately filed with the Secretary of State. Each exchange is capitalized at $25,000.

The new $100,000 switchboard of the Cuyahoga Telephone Company of Cleveland, O., has been completed and put in service. The board is equal to the one recently installed at Buffalo. In capacity, 36,000 subscribers, it is the largest board ever placed in service.

Attorney E. I. White has announced that the Syracuse, N. Y. Telephone Company has financed its bond issue made necessary by the contemplated reconstruction of its present system, and that the work will be taken up actively this spring.

The Warner Telephone Company of Buffalo, N. Y., capitalized at $50,000, has been organized with the following directors: T. S. Lane, Jamestown: A. S. Warner, Buffalo, and W. S. Lawton of Lawton.

Headquarters for the Pioneer Telephone Company, recently organized with a capital of $3,000,000. have been established in Oklahoma, Okla.

The United Telephone Company has greatly restricted its free radius in the vicinity of Chambersburg, Pa.

Independent Company Reorganized in Indianapolis, Ind.

At the annual meeting of the stockholders of the New Telephone Company, held last week, plans for the reorganization of the company were perfected. This step was made necessary, the officers say, by the rapid growth of the business and the great demand for the service, requiring large extensions in the way of cable and equipment. It has now in Indianapolis about 7,600 telephones, and connection with 1,000 in surrounding towns.

The plan for reorganization provides for the leasing of the present plant to a new company to be organized, which will be known as the Indianapolis Telephone Company.

The new company will be capitalized at $1,200,000 or $1,500,000, of which $400,000 will be in common stock, and the remainder in preferred stock.

Each stockholder of the present company will have the privilege of taking an equal amount of common stock in the new company, and in addition, will receive an amount of preferred stock.

The New Telephone Company was organized and incorporated on January 22, 1898. Its franchise is for 25 years and renewable for 25 years longer. The officers are S. P. Sheerin, president; Louis Hollweg, vice-president; H. B. Sale, secretary and treasurer. They will probably hold the same offices in the Indianapolis Telephone Company.

In a short time the two-story fireproof building for the Auburn, N. Y., Telephone Company will be completed. The building will be used exclusively for telephone purposes, the ground floor containing the offices of the company, public pay station booths, as well as a large store room. The second floor is given up entirely to the operating room, which will contain the automatic switchboards, distributing boards, ringing machines, etc., put out by the Automatic Electric Company of Chicago, as well as the toll board.

A local telephone company has been organized at Pelican Rapids, Minn., with a capital stock of $25,000. Work will be commenced as soon as the frost is out of the ground, the intention being to run lines into the surrounding country, where the farmers are ready to patronize it.

Nearly every subscriber of the United Telephone Company in Carlisle, Pa., has signed a petition agreeing to withdraw his 'phone April 1, unless the company rescinds its order to restrict the free radius in the county.

Telephone Incorporations.

The Conesville & Gilboa Telephone Company, Conesville, N. Y. Capital stock, $1,000. Incorporators: J. W. Gaylord, B. C. Wright and Elmer Baker.

The Treadwell Telephone Company, Treadwell, N. Y. Capital stock, $3,000. Incorporators: Robert B. Ballentine, Duane D. Wheat, Treadwell; V. R. Ogden, Leonta.

The Black Duck Electric & Telephone Company, Black Duck, Minn. Capital stock, $50,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alton, Ill.—The management of the Chicago & Alton Railway have decided upon electricity as the illumination for all of its passenger trains, and they will be so equipped as rapidly as possible.

Avoca, N. Y.—The subject of electric lights for this village is being agitated. President McCorn of the village of Hammondsport, accompanied by Philip Zimmer, Jr., has been here with a view of securing data on which to base estimates of the probable cost of an electric plant and the necessary accessories sufficient for lighting the streets of the village and for such public and private buildings as might require them.

Beaver, Utah.—It has been voted to issue bonds in the sum of $10,000 for the purpose of installing an electric light plant.

Chattanooga, Tenn.—The Chattanooga Plow Works will install an electric light plant and generate its own power.

Cheyenne, Wyo.—All bids for the electric lighting of the post were rejected, but will be readvertised for. Capt. W. S. Scott, quartermaster. Fort Russell, Wyo.

Clarion, Ia.—The Clarion electric light plant will be thoroughly overhauled and enlarged this spring and considerable new machinery put in.

Columbia, Tenn.—W. H. Corson states that a company contemplates installing an electric light plant here.

Concord, N. C.—It has been decided to put in electric lights here to cost $15,000.

Cottage Grove, Ore—The Cottage Grove Electric Company has purchased from W. H. Abrams the Cottage Grove electric light plant. The company intends to remove the present plant, and to install a complete new system.

Farmersville, Tex.—The Farmersville Mill & Light Company has been organized here with $50,000 capital to install an electric light and power plant, also a grain elevator. H. L. Carver and E. W. Stewart are interested.

Gilroy, Cal.—The council contemplates the installation of a dynamo in the gas works and electric lights for the streets of the town.

Grand Rapids, Mich.—James Cooper, superintendent of the Court House, has decided to advertise for bids for equipping the Kent County Home with a complete electric lighting plant.

Huron, O.—It is reported that a municipal electric light plant will be acquired by private interest.

Janesville, Wis.—This city may not buy a municipal electric lighting plant, as the bids received approximate $50,000, or $15,000 above the estimates.

Kirkwood, Ill.—A franchise has been granted to the Kirkwood Electric Company to operate an electric light and heating plant here.

Marshfield, Wis.—The city council purchased for $150,400 the electric light and waterworks, heretofore owned by the company of which former Gov. W. H. Upham is president.

Milford, Ill.—The Milford electric light plant has changed owners. E. Linder of Pecatonica, Ill., having purchased it from George Seaver.

New Haven, Ind.—Sealed proposals will be received by the trustees of this city until April 5 for the construction of a complete electric light system.

Onaway, Mich.—This village is to have a new electric light system.

Palenville, N. Y.—This town is soon to have electric lights.

Reading, Pa.—A special election will be held here to vote on the proposition to issue bonds to the amount of $200,000 for the erection and maintenance of a municipal electric lighting plant.

Ridge Farm, Ill.—The electric light plant here has been badly damaged by fire.

San Antonio, Tex.—Alex and Paul Meerscheidt are stated to contemplate installing an electric light and power plant on their irrigation farm near this city, where electric power would be used for pumping purposes.

Sebastopol, Cal.—G. W. Swain has asked for a franchise to erect and maintain an electric light and power system here.

Shreveport, La.—F. R. Hodges has asked for a franchise for gas, electric light and heating purposes. F. A. Trusten is on the council franchise committee.

Scottsburg, Ky.—The question of a new electric light plant is being considered here.

Terre Hill, Pa.—This city is agitating the question of electric lights.

Trenton, N. J.—The Indiana & Michigan Electric Company, capitalized at $2,000,000 was lately incorporated here to manufacture and furnish electric lights and power and to operate trolley lines. The incorporators are George W. Flaacke, Jr., H. Hobart Porter, Jr., and Francis Blossom, all of Jersey City.

Twin Valley, Minn.—This city is making another effort to secure an electric light plant. and this time it looks as if it would succeed.

Vincennes, Ind.—The E. M. Dean Syndicate of Grand Rapids, Mich., has purchased the citizens' gas plant and the Vincennes electric light and power plant, and will spend $50,000 in improvements.

Whiting, Ind.—The Lake County Light & Power Company has been incorporated with $100,000 copital, and will build an electric light and power plant here. R. J. Cary and S. T. Chase are interested.

Wilson, N. Y.—A company with a capital stock of $3,000 will build an electric plant to furnish the residents with street and house lighting, and also for power purposes. A. F. Bowker, F. H. Tower and E. Tower, of this place, are interested in the movement.

STREET RAILWAYS.

Bath, N. Y.—John Tuerk, of New York City, has applied for a franchise to construct and operate an electric railroad here.

Danville, Ky.—Dr. M. Crow, of Versailles, will soon lay before the city council a proposition concerning the construction of an electric road between this city and Junction City.

Elizabethtown, Ky.—An electric railroad from Buffalo to this city will shortly be built. The capital is in sight, and an engineer will probably be employed at once to make the survey.

Iowa City, Ia.—An electric street railway system will be installed here by the Iowa City, Davenport & Muscatine Electric Railway Company.

Jamestown, N. Y.—A certificate of merger of the Warren & Jamestown Electric Railway Company with the Warren & Jamestown Electric Street Railway Company, has been filed at Albany with the Secretary of State.

Monroe, Mich.—Peter Jacobson, who promoted the Detroit & Monroe Electric Railway, is endeavoring to secure another electric railway from here to Dundee.

Nahant, Mass.—The Nahant Street Railway Company has been granted a franchise to build an electric road between this place and Lynn.

Napoleon, O.—The Lake Erie, Bowling Green & Napoleon Electric Railway Company has issued and sold $1,000,000 5 per cent. 30-year gold bonds, the money to be used to extend the present line to Fort Trenton and this city.

Richmond, Va.—The corporation commission has issued a charter to the Seaboard Traction Company, composed principally of Norfolk capitalists, to operate an electric passenger and freight line, 300 miles long, between this city and Portsmouth and through the principal truck and peanut section of the State. The capital stock is fixed at $250,000 minimum and $800,000 maximum.

Valparaiso, Ind.—The Northern Traction Company proposes to build a road from South Bend to Hammond.

Warrensburg, N. Y.—The Delaware & Hudson Railroad Company is said to be backing a proposed extension of the Hudson Valley Electric Railway through the Adirondacks from here to Elizabethtown. Charles S. Taylor is interested.

Warsaw, Ind.—The estimated cost of building the Goshen-Warsaw electric line is $600,000.

Woodland, Cal.—N. A. Hawkins has secured a franchise for an electrical railroad through the central part of Yolo County in the vicinity of this city.

York, Pa.—The York County Traction Company will soon consider the proposition to increase its capitalization from $1,500,000 to $5,000,000.

POWER PLANTS.

Spokane, Wash.—It is proposed to develop power on the Spokane River, 25 miles from this city, where a flume will be constructed to supply a 33-foot fall. Electricity is to be furnished this city and other points. David Wilson is interested,

Syracuse, N. Y.—An effort is being made to interest local capitalists in the plan to develop electric power from Northern New York streams for transmission to this city and elsewhere in Central New York. Assemblyman Merritt of St. Lawrence County has introduced a measure into the Legislature at this session to give any such company the right to condemn property for a right of way for high tension wires for the transmission of the power.

Quebec, Can.—Another electric company is likely to be formed shortly under the name of the Quebec Electric Company, several local men being interested in the new concern. The plan is to install a hydraulic electric plant at Seven Falls on the River of St. Anne in Montmorency County.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅜@12⅝c.; Lake 12½@12¾c.; casting, 12⅜@12⅝c.

Otis Elevator dividends are payable April 15. Books close March 30 and reopen April 16.

According to Electric of America interests, earnings since the first of the year have equalled those for the corresponding period of 1903.

The Union Traction Company of Indiana has declared a dividend of 2½ per cent. on its preferred stock, payable April 1 as registered March 21.

At the annual meeting of the stockholders of the United Electric Company of New Jersey, held in Newark, the number of directors was reduced from 21 to 8.

The Cumberland Telephone & Telegraph Company will pay the regular quarterly dividend of 1¾ per cent. on April 1. Books close March 20.

The recent heavy selling in the Metropolitan Street Railway issues in New York was attributed to James R. Keene, who was said to be liquidating holdings of the late W. C. Whitney.

It is reported from Pittsburg that the Philadelphia Company has bid $2,000,000 for the Murray Verner Traction Company franchise and that the owners are holding out for $2,500,000.

The Indiana & Michigan Electric Company capitalized at $2,000,000, has been incorporated in Trenton, N. J., to manufacture and furnish electric lights and power and to operate trolley lines.

The executive committee of the General Electric Company will meet next week to take action on the common dividend, which will be paid April 15. The usual rate of 2 per cent. quarterly is expected.

The Committee on Railroads of the New York Board of Aldermen will give a public hearing at City Hall at 3 P. M. on March 18 on the petition of the Union Railway Company for the grant of a franchise to construct and operate a street surface railway in the City of New York.

The creditors of the Michigan Electric Company, after hearing a report from the committee appointed to appraise the assets, have decided to authorize the sale of the assets and business by the Union Trust Company as receiver, with the co-operation and advice of the committee.

A meeting of the stockholders of the Springfield Railway and Light Company will be held on March 17 at the office of the company, 419 Market street, Camden, N. J., for the purpose of electing a board of seven directors to serve for the ensuing year and to transact such other business as may be brought up for consideration.

The National Carbon Company, it is reported, will spend $200,000 during the present year in the construction of a new plant to meet the development of its business. It will not be located in Cleveland, but at some other point, not yet named, where it will be nearer the source of the business handled. It is understood that it will probably be at Chicago.

New York Traction stocks fared badly in Wall street on Saturday. Metropolitan lost 4⅛ points, Metropolitan Securities 8 points to 75, and Third Avenue 2½ points to 117½. In some quarters the selling was explained on the score of the addition of the Elsberg bill to the bill of the Rapid Transit Commission. The bill, it was said, would defeat the entire measure and prevent the further construction of subways.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Mar. 14
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	140
Metropolitan Street Railway	105¾
Metropolitan Securities	74¼
Ninth Avenue	200
Third Avenue	115½
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	40
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	63
Philadelphia Traction	97¼
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	140
West End Street, com	90½
do. do. do. pref	109
Chicago.	
City Railway	161
North Chicago	87
Union Traction, com	6
do. do. pref	32½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	24
do. do. pref	54
Electric Lead Reduction	⅞
Electric Vehicle, com	8
do. do. pref	12
Westinghouse, com	157
do. pref	194
General Electric	160
Boston.	
Edison Electric Illuminating	234
General Electric	160¼
Massachusetts Electric Companies, com	17¾
do. do. do. pref	71½
Westinghouse Electric & Mfg., com	78
do. do. do. pref	89
Chicago.	
Chicago Edison	152½
National Carbon, com	25½
do. do. pref	98
Philadelphia.	
Electric Company of America	7¾
Electric Storage Battery, com	55
do. do. do. pref	55
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	121
Western Telephone Company	9
New England Telephone Company	119
New York.	
American Telegraph & Cable Company	84¾
Commercial Cable Company	191
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88⅛
Miscellaneous.	
Chicago Telephone Company	118
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	34
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

"Union Home for You All." Mr. Andrew Carnegie sailed for Europe on Saturday, but before his departure he settled the question about erecting the engineering building, doubt about which had arisen on account of the refusal of the Civil Engineers to unite with the other engineering societies in accepting Mr. Carnegie's offer. He not only stands by his original proposition, but also adds the half million dollars which was to go for the sole benefit of the Civil Engineers, as will be seen by the following letter:

"Gentlemen of the Mechanical Engineers, Institute of Mining Engineers, Institute of Electrical Engineers, Engineers' Club of New York: It will give me great pleasure to devote, say, one and a half million of dollars for the erection of a suitable Union Home for you all in New York city. With best wishes, truly yours, Andrew Carnegie."

Prompt and energetic work is now being done by the men selected to represent the above-named societies. Saturday afternoon the Building Committee met at the Engineers' Club and reorganized, subdividing the work of plan and scope and erection of new buildings. The American Society of Mechanical Engineers was represented by J. M. Dodge of Philadelphia, C. W. Hunt and Prof. F. R. Hutton of this city, and Colonel Muir. The American Institute of Mining Engineers was represented by A. R. Ledoux, Charles Kirchoff and Theodore Dwight of this city. The American Institute of Electrical Engineers was represented by C. F. Scott of Pittsburg, B. J. Arnold of Chicago, and S. S. Wheeler of this city. The Engineers' Club was represented by John C. H. Kafer, W. H. Fletcher and T. Commerford Martin.

The reorganized General Committee is composed of Charles F. Scott, chairman; A. R. Ledoux, vice chairman; John C. Kafer, treasurer, and Prof. F. R. Hutton, secretary.

* * *

A Bell Company's Poor Service. Elsewhere in this issue will be found the continuation of an excellent article on the Independent telephone movement by Mr. J. B. Ware. The people of the middle West are not the only ones that are dissatisfied with the Bell service. As the author of the paper already referred to states, however, in the East the Bell monopoly has to a great extent controlled the Legislatures and thereby kept out competition. In this connection it is interesting to note that as a result of the continued unsatisfactory service which is being rendered to the patrons of the telephone by the Chesapeake & Potomac Telephone Company in the District of Columbia there has been introduced a bill before Congress for the purpose of granting a charter to a new company, to be known as the District Telephone Company, which is to render service to its patrons at a cost not exceeding $36 per year for private residence 'phones and $48 for public offices. The capital of the new company would include $1,000,000 and a bonded issue of stock to a like amount, the books for the subscription to same to be opened up in the District, and not less than 10 per cent. of all stock taken would have to be paid up to commence. It is also provided that the District should be authorized to give the necessary permits for the construction of conduits, etc. With the present state of strained feelings existing in the District, and the pressure that is being brought to bear on Congress as a consequence, it would not be at all surprising if the bill should be passed.

Will Require Large Capital.

Since the recent announcement in ELECTRICITY of the proposed combination of the Bullock Electric Company and the Allis-Chalmers Company there have been many changes in the official staff of the latter company, and already there is considerable speculation about what effect the new "combine" will create in the electrical trade. It is claimed among electrical experts that it will require from $12,000,000 to $14,000,000 of new capital and the energy of a great force of skilled mechanics to make successful the electrical combination proposed.

The invasion of the Corliss and gas engine field by the Westinghouse and General Electric Companies is believed to have induced the proposed combination on the part of the Milwaukee engine builders.

It is estimated, however, that the manufacture of electrical machinery, as heavy as that made by the General Electric and Westinghouse Companies, and to correspond to the heavy engines now built at Milwaukee, will require at least $1,000,000 for patent rights and designs, fully $500,000 for new patterns and $2,000,000 more for new equipment and tools. In addition it will require $3,500,000 of new working capital and $4,000,000 for material entering into electrical machines that will require two years to build. It will also require a long time to gather together a sufficient force of electrical engineers to make successful the invasion of the electrical field.

It is pointed out that the General Electric and Westinghouse Companies have been able to save immense sums of money by reason of their alliance in respect to patents and that litigation on patents might form a costly item in any new venture in the field now held between these two companies.

* * *

Continuous vs. Induction Motors.

Mr. H. M. Hobart, whose name has become quite a household word among English and Continental electrical students because of his valuable contributions to the scientific societies and the electro-technical press on matters relating to the design of motors and dynamos, discussed the rated speed of electric motors as affecting the type to be employed before the London Institution of Electrical Engineers on March 10. For the continuous current motor, he remarked, high speed is an unfavorable condition, but up to certain limits such speed conduces to improved results for induction motors. It is true that the required speed can rarely be the determining factor in the choice between these two classes of motors, but Mr. Hobart, with a view to emphasizing the extent of the influence of speed selected a set of continuous current designs and two sets of induction motors, and by means of curves roughly indicated the relative factory costs of eleven designs in these three groups. The continuous current designs were for a 150 hp. shunt motor, and the five speeds ranged from 68 r.p.m. to 1,224 r.p.m. In regard to the induction motors, the first group was for 21 cycle motors ranging from 36 poles and 68 r.p.m. to 4 poles and 612 r.p.m., and the second group was for 63 cycle motors ranging from 12 poles and 612 r.p.m. to 6 poles and 1,224 r.p.m. He found that for motors having equal rotor dimensions the continuous current motor could be taken as costing 50 per cent. more than the induction motor, but this would not represent the ratio of cost for the same output, because different diameters and lengths would be taken in the two cases. It appeared from the curves that with increasing speed, while all the properties of the induction motor improved markedly, the reverse was the case for the continuous current motor. This result might be considered to point out the best field for the respective types, and that the influence of the speed should be taken into account when other circumstances permit.

The main conclusions which were set forth as the result of Mr. Hobart's investigations are not new, but it is held that they must be much more widely understood if the electrical transmission of power is to proceed on rational lines. They are as follows: (1) Induction motors are, for all capacities, considerably cheaper than continuous current motors of equivalent ratings. (2) The general performance and the mechanical construction of induction motors improve rapidly with increasing rated speeds. (3) The general performance and the mechanical construction of continuous current motors improve rapidly with decreasing rated speeds. (4) The use of very low-speed induction motors and very high-speed continuous current motors ought to be avoided whenever this is commercially practicable.

With a flourish of trumpets to the outside world, the city authorities of Holyoke, Mass., organized a municipal lighting plant and it now appears that it is not to be the success that was predicted. One of the net results is a cost of $153 to the city for street lights which the company had previously agreed to furnish for $75. The profit of $7,159 in the year's business is in effect a deficit because of the loss from taxes formerly levied on the concern when owned by private capital.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Conptroller Grout introduced a resolution, which was adopted, at the Rapid Transit Commission Friday, providing for the operation by the city of New York, of subway lines, if approved by vote of the people.

For the purpose of studying mining, scientific and industrial enterprises in this country a commission composed of four Frenchmen, an Italian, a Belgian and a Swiss arrived in New York Saturday on the Savoie, of the French line. The members will spend about two months in the United States, visiting not only the leading mining and industrial centers, but taking in many other points of interest. In charge of the party is Prof. Geogg, who holds the chair of industry in the High School of Commerce in Geneva.

Muskrats by burrowing through the embankment of Mohawk Lake, from which power was obtained for the electric light plant at Brantford, Ont., caused the water to flood vacant fields instead of flowing to the plant, entailing a loss of $5,000 to the company.

A fine collection of telephone curios has been secured by B. F. Wasson, who has charge of the exhibit which will represent the evolution of the Independent telephone at the World's Fair at St. Louis.

The office of the Western Union Company in Augusta. Ga., will accept messages for transmission to a number of the ocean liners which have been provided with Marconi apparatus. The rate is $2.50 for ten words, and 15 cents additional for every word over ten.

Two interesting papers, one by C. Renshaw on "Present Electrical Railway Practice" and the other on "Adaptation of Alternating Currents to Railway Purposes," by P. M. Lincoln, were read before the Engineers' Society of Western Pennsylvania in Pittsburg at its meeting last week. The subject for discussion was the traction car with its electric power, and the means of application and operation of electricity in that field was discussed in detail.

POLE LINE WORK IN MANILA.

Some time ago there appeared an article in ELECTRICITY (November 18, 1903) descriptive of the various types of telegraph and electric light poles made use of in Manila, Philippines. The correspondent of ELECTRICITY in that locality recently forwarded a number of photographs of the poles themselves, which

Pole Line Construction in Manila, Philippines.

appear in this issue. As will be seen the poles are of wood, frequently spliced together to make them the desired height. It might be added that the poles now in use are a great improvement over the light bamboo poles erected by the Spaniards.

PRESENT INDEPENDENT TELEPHONE SITUATION.*

BY J. B. WARE.

(*Concluded from page 150.*)

In a large portion of the State of Illinois, the same general results have been attained, as in a majority of the States already mentioned. In Chicago, the Illinois Telephone & Telegraph Company (the Automatic) has its tunnels completed, 40 feet below the streets, and under the most important business sections of the city. There are over 22 miles of these tunnels at the present time. This company has already constructed one exchange on the corner of Fifth avenue and Monroe streets, which has 4,000 automatic telephones in service. It is expected this company will have over 20,000 telephones working in Chicago within the coming twelve months. The plan has been announced to construct long distance lines from Chicago to the connecting lines of the other Independent companies. Actual work on this development is to begin in the spring.

In Wisconsin, the Independents are rapidly growing, and have over 35,000 telephones, which number is greater than the Bell telephones in the State, outside the city of Milwaukee.

Iowa is the home of many companies, there being over 1,200 Independent companies in that State, with many more telephones than has the Bell. The long distance lines are now receiving more than usual attention, and the people of Iowa will soon have adequate exchange and toll line facilities.

Missouri is also ours. St. Louis, with its more than 12,000 'phones, exceed in number those of the Bell; Kansas City's new exchange has just opened, built for 12,000 subscribers, and it has every prospect of driving the Bell to the wall. St. Joseph, Jefferson City, Hannibal, Joplin, Springfield, Clinton, in fact, all the cities of the State have Independent exchanges; and it is estimated that there are twice as many Independents as there are Bell telephones in Missouri. Excellent long distance lines are being constructed, and the future is assuredly favorable *only* to the Independents.

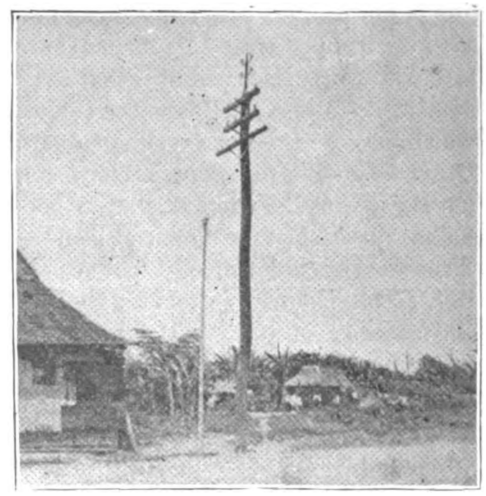
In Kansas, the number of Independent telephones exceeds 50,000, while the number of the Bell is less than 9,000. In Oklahoma, a condition very similar to that in Kansas prevails. The long distance system connecting Missouri, Kansas and Oklahoma are about completed, and as a rule, are of better construction than are the lines in many of these sections.

In Nebraska, the Dakotas, and other Western States, the movement is well established and steadily growing.

In the Coast States of the extreme West—California, Oregon and Washington—a very remarkable development has taken place during the past two years. Thus, Southern California has been completely developed by the Independents. In Los Angeles they have 12,000 telephones in service and are growing at a tremendous rate. In Portland, Ore., and in Seattle, Wash., fine exchanges have been recently completed.

The indications are that California, the heretofore famous stronghold of the Bell interests, will within a very short time pass into the control of the Independents, and thus be forever freed from the Bell domination, with its high rates and low quality of service.

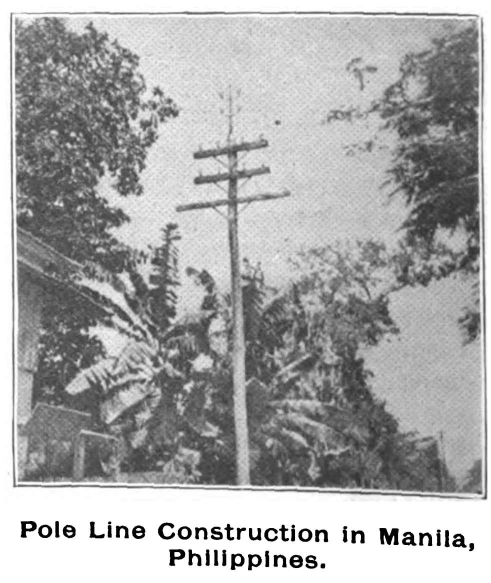
I have not as yet, nor will I, take up in detail the very gratifying situation in Michigan, as you are familiar with the same. We have about 50,000 telephones in the State, as against the 51,000 claimed by the Bell. If Detroit and that portion of the other cities "sold" four years ago, and which as yet have not been redeemed, are omitted, we have over 20,000 more telephones in service than has the Bell Company.



Pole Line Construction in Manila, Philippines.

As the result of the 25 years' history of the Bell movement it has less than 1,500,000 telephones now in use by its exchange subscribers in the United States. The result of the eight years of the Independent movement shows 2,000,000 telephones in service. Of the 180 cities having over 25,000 inhabitants, according to the last census, 70 per cent now have independent exchanges in operation.

In conclusion, I wish briefly to refer to the very satisfactory financial success, as a whole, of this movement. Few in-



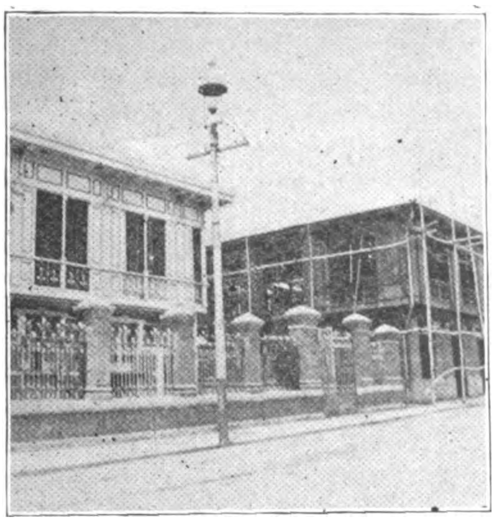
Pole Line Construction in Manila, Philippines.

deed, have been the number of failures among the more than 6,500 Independent companies. The Bell company has compiled and is widely advertising its record of these failures, which number less than

*Paper read at the annual convention of the Michigan Independent Telephone Association held in Detroit, Feb. 25, 1904.

a score—not one of which occurred in our own State.

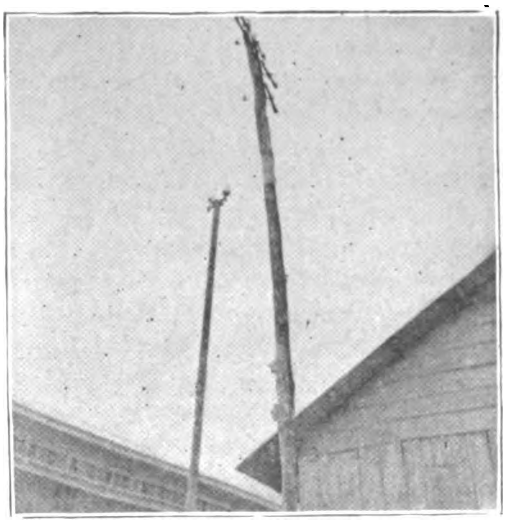
The cities of Boston, New York, Washington, New Orleans, Cincinnati, Chicago, Milwaukee and San Francisco, are the only cities having more than 200,000 population, in which telephone competition is not established; and Chicago must soon be dropped from this list as heretofore shown. Each of the cities just named has a local Bell licensee company, which is at present very prosperous. Other licensee Bell companies have ceased paying dividends, and are understood to be in unsatisfactory financial condition. Even the parent company (the American Tel. & Tel. Company), owning as it does the majority of the stock in each of its many licensee, or Bell Companies, and dependent for its financial success upon the royalties which said companies pay on each telephone used, has apparently been seriously affected by the Independent competition, as indicated in part by the



Pole Line Construction in Manila, Philippines.

falling off in price of its stock from 167 in April 1902, to 117 in October, 1903, its present price ranging about 122.

The various licensee or operating companies of the American Bell were capitalized years ago, and before competition existed, resulting in over-capitalization under present conditions. It seems certain that these companies cannot continue to pay interest on their securities, and also the royalties to the American Tel. & Tel. Company The policy of the American Tel. & Tel. Company may possibly be foreshadowed as to its subordinate companies in the recent failure, foreclosure sale and reorganization of the Michigan Telephone Company, in which it held over 70 per cent. of the capital stock. Its property was sold by the Union Trust Company of Detroit, as receiver, the sale realizing about 80 per cent. of the mortgage foreclosed. The stockholders (some 743) lost all, being $1,312,700. The American Tel. & Tel. Company owned $3,687,300 of said stock, which was cut



Pole Line Construction in Manila, Philippines.

off by said foreclosure sale, as was also an indebtedness owing by the Michigan Company to the American Tel. & Tel. Company and its subordinate companies, amounting to over $2,500,000. It would thus appear that the American Tel. & Tel. Company loses over $6,000,000 by this failure.

It is possible that some secret arrangement exists by which the parent company secures in the reorganization of the Michigan Company some compensation not apparent to the public. It is possible that the parent company expects by the reorganization plan to secure the payment of its royalties which is absolutely essential to the American Tel. & Tel. Company's existence. It is an interesting and grave question, however, whether there exists any rational solution to the desperate financial problem now confronting every Bell organization—whether there is yet one chance to save permanently valuable telephone property, which, through a wrong policy and mismanagement under same, has been brought to the very verge of a financial precipice which is as surely destructive as is the great Niagara to unfortunates once engulfed.

The failure of the Michigan Bell Company, as stated, involves more property, and a loss to stockholders many times greater than the aggregate value of property and losses involved in all Independent telephone failures during the past seven years of their existence.

In the United States there are 4,700 national banks, and 1,078 savings banks (World's Almanac, 1904), making a total of 5,778 such banks. It is claimed, and I believe properly so, that the number of these bank failures, during each of the past five years, have exceeded the number of telephone companies (both Bell and Independent) that have failed during that entire period. No other class of business can make such a splendid showing, and no other business is of greater permanency or in greater demand in both the commercial and social world.

That the future appears to have an abundance of success and comfort to the Independents, none will deny, who are both posted and honest. That the same future appears to have very much of disaster and sorrow to the many Bell interests seems assured. Knowing their ability to furnish the very best quality of telephone service and at the lowest reasonable rates, and knowing that they have the confidence of the people, the Independent companies will go on to that assured success to which they are entitled by reason of their past efforts and their past accomplishments.

DASH POTS FOR CORLISS ENGINES.

ARTICLE IV.

BY W. H. WAKEMAN.

Working engineers who have given the theoretical part of their business little attention, find it difficult to read a drawing or understand a cut. The ability to do this can be acquired by every man in charge of a steam plant, although it takes some much longer than others. It is a good idea to begin the study by taking plainly made illustrations which relate to simple devices, such as are illustrated in this series of articles.

Sometimes an engineer will take up a paper, and if he happens to see something that he does not understand, he may throw it down and give it no further attention. This is certainly a mistake, for mechanical papers are published for the purpose of explaining things that their readers do not fully understand, thus enabling them to do better work because their efforts are more intelligently directed.

For an application of this advice, take Fig. 8 which illustrates a simple form of dash pot. In this case the pin which passes through the ears, 2 and 3, is shown at 4, but the rod is omitted. However it fits in between these ears and the pin, 4, passes through it, being a sliding fit at this point.

The plunger is now in its lowest position, but when raised a partial vacuum is

formed under it in the chamber, 5. The plunger is fitted with three packing rings as shown, to assist in keeping it air tight. No means are provided for letting air out of this chamber.

In order to understand the cushioning device, suppose that the dash pot plunger is raised to its highest position, and has just begun to descend.

The outer part of it (shown at 6) is now up far enough to let air circulate under it freely, but as it descends the tendency is to confine this air in the chamber 7. It will be noted that at the lower part of 6 the bore is enlarged. The object of this design is to gradually confine the air and avoid a sudden closure of the passage through which it escapes. This results in bringing the plunger to rest without shock

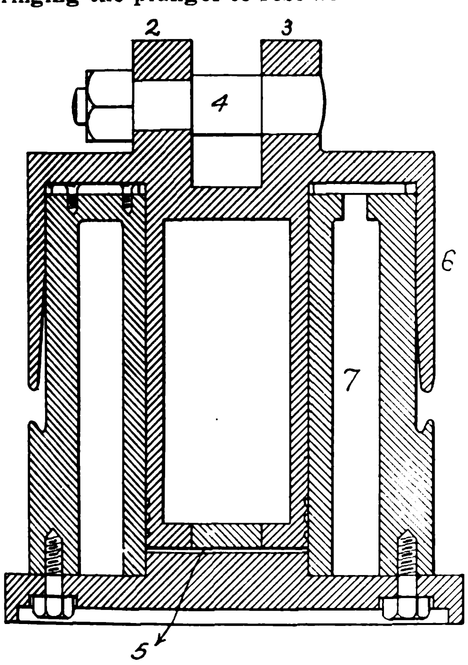


FIG. 8.

or jar. The amount of cushion cannot be regulated, as the manufacturers seem to think that the device is perfect when it leaves their hands, and that it will always remain so.

The dash pot shown in Fig. 9 is a trifle more complicated in design but its operation will be easily understood from the following description.

The upper part of plunger, 2, is smaller in diameter than the lower, therefore as it moves the amount of air displaced is not the same in both cases, and this difference is further increased by the design of other parts. Special attention is called to this point, because it is the main principle on which the operation depends.

In the cut the plunger is ascending and is now about midway of its travel; 3 is a chamber under the larger part of it, and 4 is another chamber which extends entirely around the plunger. It is formed by reducing the diameter of the upper part as shown. These two chambers are connected by the passage, 5, therefore as the plunger ascends the chamber, 3, is enlarged several times faster than 4 is diminished, making a strong downward

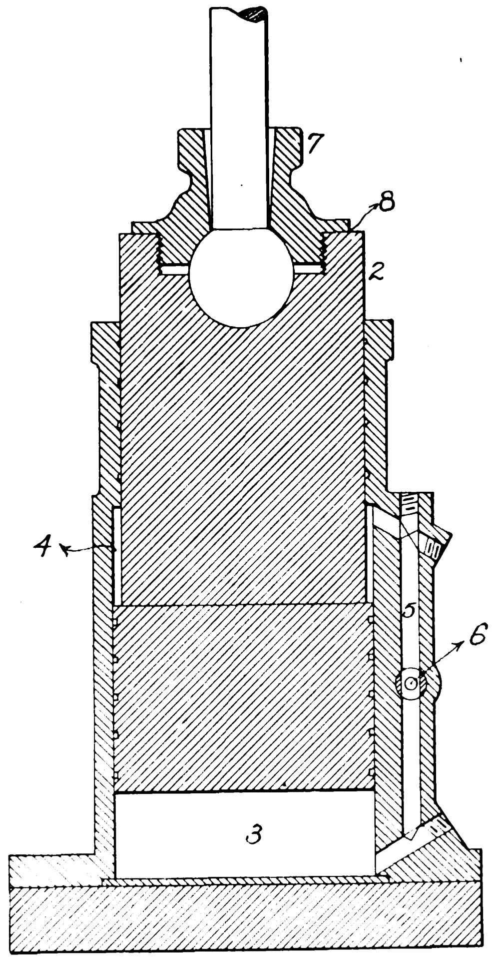


FIG. 9.

draft of air through 5, or to use an expression common among engineers, it creates a strong suction at this point, removing about all of the air from 4 and at the same time creating a partial vacuum in 3.

From the above description and explanations preceding it, of the action of air in dash pots, it will be seen that when the plunger has reached its highest point, and the valve crank is disengaged from the wrist plate connection, the cut-off valve will be closed very quickly.

Let us suppose that the plunger is next raised as high as it can go and follow its operation downward. At first the effect of a partial vacuum in 3 is very strong, and here is where it is needed most.

As it begins to descend the air pressure in 3 is increased, forcing it up through the passage 5 into 4, but it cannot travel fast enough to entirely relieve 3, neither is there room enough for it in 4, therefore the plunger comes to rest gradually.

A peculiar feature of this dash pot is found in the fact that no air is discharged from it, as with those already illustrated, but the same air is kept in circulation. A valve is located at 6, which may be used to obstruct the passage 5 and thus regulate the whole operation.

Nine packing rings are used to prevent the escape of air around the upper and lower parts of the plunger, as shown in the cut.

The rod is connected to the plunger by a ball and socket joint, which allows it to swing in any direction. Lost motion at this point is taken up by unscrewing the nut, 7, putting it in a lathe and removing some of the iron at 8. Care must be exercised not to remove enough to make the nut clamp the ball.

Dash pots are designed so that when they are lifted to their limit the greater force is brought to bear to bring them down, and this is proper, because it is needed at this time. One reason for this is found in the fact that when a cut-off valve is opened wider than usual it does not close so easily, as new wearing surfaces are brought into contact with each other. On general principles, the wider a valve is opened the more force it requires to close it.

THE RIEDLER-STUMPF STEAM TURBINES.*

BY WALTER RAPPAPORT.

The heat energy of steam can be thoroughly utilized in steam turbines in different manners. First, the steam can be allowed to expand in conical nozzles, and then the kinetic energy be turned to account. The first steam turbine which utilized the steam in this way was the de Laval turbine. But theory proves to us that in such purely action turbines the circumferential velocity must be equal to half the steam velocity, which with the present customary pressure of at least 140 lbs. per square inch, amounts to about 3,600 feet per second, in reality even somewhat greater, as the angles of the vanes at the points of entrance and exit are not zero. In the de Laval turbine this would, therefore, necessitate a circumferential velocity of 2,000 feet per second, a moving wheel of about 20 inches diameter, making 30,000 revolutions per minute. These figures are practically not applicable, and so de Laval was forced to gear down this high rotary motion of the wheel, whereby, of course, the economy was greatly diminished.

A one-wheel purely reaction turbine is out of the question, for the reason that here the circumferential velocity must be equal to the steam. velocity, the number of revolutions, therefore, being twice as many as in the de Laval turbine. Parsons made use of the pressure in different

*From the "Electrical Review," London.

stages, and in this way achieved satisfactory results, although the number of revolutions cannot be decreased *ad libitum*, as the application of a great number of stages would increase the internal friction greatly and make the machine extremely complicated. The latter drawback was removed by Rateau, who used but few stages, but let each wheel rotate in a closed chamber.

A third means of reducing the number of revolutions is by charging the steam with specifically heavier gases, as has been attempted by Escher, Wyss & Co. in Zurich. These trials were, however, unsuccessful, as it was impossible to completely regain the mercury vapors which were employed.

Recently Profs. Riedler and Stumpf have published turbine constructions which aim at reducing the number of revolutions as much as possible with economical utilization of steam. First, they constructed wheels on the de Laval principle, but increased the diameter of the wheel considerably, up to 6.5—7.7 feet diameter, so that the necessary circumferential velocity

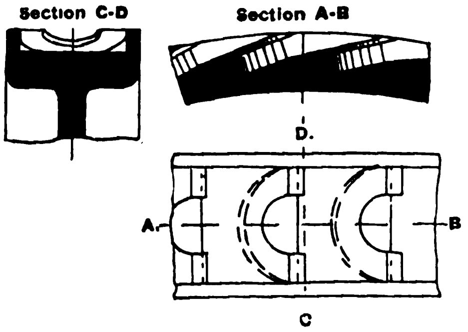


FIG. 1.
Blades of a Riedler-Stumpf Turbine.

was attained without having to reckon with an enormous—practically impossible—number of revolutions. The wheels are constructed as massive nickel steel disks, the factor of safety being five. The wheels are balanced very exactly so that the center of gravity is precisely in the center of rotation. The bearings are contrary to those in the de Laval turbine, placed quite near the disk, and the blades not inserted singly, but milled like pockets in the rim of the wheel as shown in Fig. 1. The pockets may also be constructed in pairs, and then are similar in form to the buckets of a Pelton wheel. Whereas de Laval employs at the most eight nozzles with elliptical outlet section placed singly, the Riedler Stumpf construction has nozzles of rectangular section close to one another on the whole circumference of the moving wheel, so that the string acts in a broad ring. The play between the stationary and moving parts can thereby be ⅛ inch — 1/12 inch, contrary to the Parsons construction. A turbine of the aforesaid construction of about 2,000 hp. capacity is set up and working in the Moabit electric supply station of the Allgemeine Elektricitats-Gesellschaft. The steam pressure is 200 lbs. per square inch

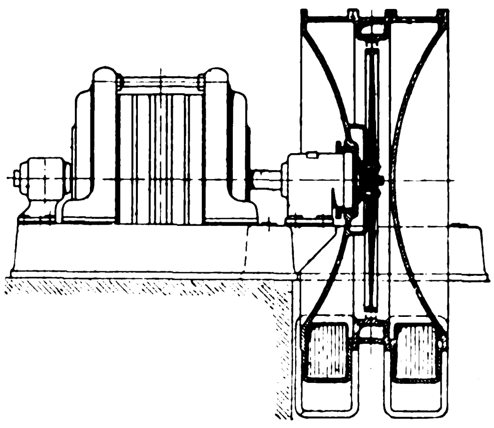


FIG. 2.
Riedler-Stumpf Turbine of 2,000 Kw. Capacity.

absolute, at a temperature of 294 degrees C., and the vacuum in the condenser is only 85 per cent. The wheel of this turbine weighs only 850 kg., and is direct coupled on the overhang of the heavy dynamo shaft, so that a simpler turbine can scarcely be imagined, and the mechanical efficiency amounts to nearly 100 per cent. Fig. 2 shows this turbine.

Instead of using the kinetic energy of the steam in one row of blades, it can be utilized in several wheels in succession. Only a part of the energy is used for the first wheel, this being easily achieved by suitably dimensioning the angles of the veins at the points of inlet and outlet,

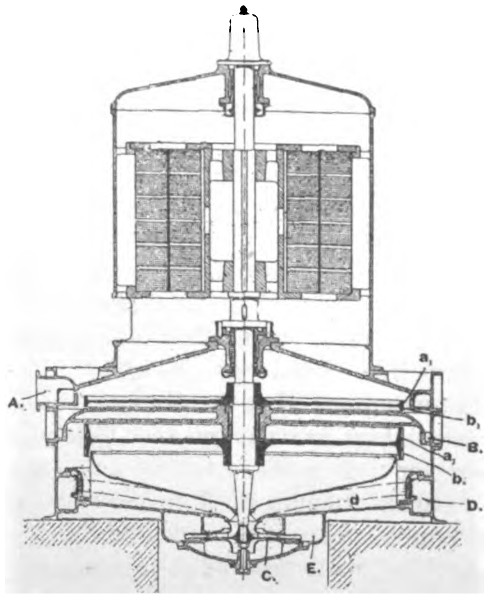


FIG. 3.
2,000 Kw Riedler-Stumpf Turbo-Generator.

guiding over the steam to a second moving wheel, where it again loses a part of its energy, and then, if desired, to a third and fourth wheel. Too many velocity stages would injure the economy of the turbine, as the friction of the steam would then become too great. There are two methods of construction to carry out this principle; the steam is either carried from the expansion nozzles over the first moving wheel, and from here by reversing guide blades back again to the same vanes, or the steam may be carried to a second wheel. The first construction is naturally the simpler and cheaper, but it only allows the steam to act on a part of the circumference. The second has the additional advantage of permitting the construction of the blades of both wheels with different angles, according to the steam velocity at these points. This type of turbine has already been built in sizes from 20—500 kw. by the A.E.G. The smaller constructions are well adapted to be placed on the boiler of a locomotive, where, in connection with a generator, they serve to illuminate the train.

A third turbine construction, having great resemblance to that of the American Curtis, has at the same time pressure and velocity staging. The steam expands in nozzles to a certain degree and then transmits its kinetic energy to diverse wheels in succession, it then comes to a second system of nozzles, expands there still more, and gains further velocity, etc., till its pressure has dropped down to the atmosphere or condenser pressure, and it has lost all velocity. The construction of the turbo-generator is shown in Fig. 3. At A the steam enters into the first nozzles and then impinges upon the moving blades a_1 and b_1. In this first pressure stage double velocity staging is applied. From b_1 the steam goes to the second nozzle system, B, the pressure drops down to the condenser pressure and the steam acts on a_2 and b_2. In all there are two pressure stages, each having double velocity stages used in the machine shown in Fig. 3, which possesses a capacity of 2,000 kw.

A special feature of the Reidler-Stumpf turbines is the attaching of centrifugal jet-condensers to the turbine shaft itself. Such an apparatus is shown at C in Fig. 3. The steam enters through the annular channel, d, from the last moving wheel to the condenser wheel and mixes with the cold water coming in through pipe D. The mixture flows off through pipe E. Such an arrangement is, of course, not only possible with vertical, but also with horizontal construction, where, for instance, the turbine is overhanging attached to the one end of the dynamo shaft and the condenser wheel to the other one.

Another proposition has been made, to omit the reversing guide blades for velocity staging and to replace them by wheels rotating in the contrary direction.

The steam would, therefore, first expand in a nozzle, then lose a part of its velocity in revolving the first wheel, and act on a wheel running in the contrary direction, then again act on a third wheel running parallel to the first one, and so on. The advantage would be that the steam would act on several wheels with less friction and in unchanging direction. In the construction, however, according to this principle, the admission and exhaust of the steam would involve difficulties.

Prof. Riedler in his paper read at the Berlin meeting of the Schiffbautechnische Gesellschaft (Society of Naval Engineers) gave some figures on the economy of his turbines which, of course, admit of considerable improvement, as they are still in the first stages of development; notwithstanding this, remarkable results have already been attained as given in the follow ing table :

Where working.	Capacity.	Steam pressure lbs. per square inch.	Condensed pressure lbs per square inch.	Number of revolutions.	Temperature Centigrade, degrees.	Steam consumption per kw. hour—lbs.
Berlin Electric Supply Works.	1,365 kw.	130	2.1	3,000	294	19.6
	1,920 hp.	170	1.2	3,800	300	17.4
At half load..	850 kw.	116	9.2 per cent (vacuum)	3,000	290	20.3

ELECTRICAL STATION PRACTICE.

ARTICLE XXIX.

BY W. H. RADCLIFFE.

The storage battery, secondary battery, or, as it is most generally termed, the accumulator, has been developed within a few years from the experimental stage to a recognized factor in the operation of most small electrical stations and in the operation of many of the large stations where direct current is generated. Installed therein it serves as a means of equalizing the current and reinforces the generators during periods of heavy load.

As is well known an accumulator itself provides a method of apparently storing or accumulating current electricity. It does this by undergoing a chemical change when a current is forced through it in the reverse direction to that of the current it afterward supplies when disconnected from the source and placed on closed circuit. The form of accumulator best adapted for electrical station work is that of the Plante type. This type as manufactured by the Electric Storage Battery Company, one of the largest and best known concerns engaged in this business, consists essentially of three parts—the containing vessel or tank, the electrodes or plates, and the electrolyte or acid solution contained in the vessel or tank for excitation.

The containing vessel or tank may be either a heavy glass jar, a rubber jar, an all metal tank, or a wooden tank treated with acid-proof paint and lined with lead. Of these, glass jars and lead-lined wooden tanks are best adapted for station practice. The size of the jar or tank is governed by the size and number of electrodes or plates employed.

The electrodes or plates in each accumulator are composed primarily of an alloy of lead and antimony, the antimony being added to harden the lead. There are a number of perforations in each plate, and in these are pressed buttons of the same shape as the perforations which in the positive plate are round but in the negative plate are square. The buttons in the positive plate constitute the active material of the accumulator and consist of peroxide of lead (PbO_2) when the battery is charged. The positive plate is the one from which the current developed in the battery passes to the outside connecting circuit, and it is also the one whereat the charging current enters the battery; it may be distinguished from the negative plate by its color, which is a dark brown. The buttons in the negative plate consist of pure lead (Pb) and when the battery is charged are reduced to a state of fine subdivision. The negative plate may be distinguished from the positive plate by its color, which is a dark gray, and also by the fact that the number of negative plates generally exceed the number of positive plates by one in order that the latter may be placed to the greatest advantage.

The electrodes or plates in each accumulator vary in size and number, according to the capacity in ampere-hours it is desired to obtain therefrom. The unit "ampere-hour" means one ampere delivered for one hour. Thus, an accumulator having a capacity of 300 ampere-hours and delivering 30 amperes will, if permitted, continue to discharge at this rate for $300 \div 30$ or 10 hours and still retain the necessary amount of residual charge for preserving the plates. If a current greater than 30 amperes be drawn from the accumulator the time required to exhaust the original charge will be proportionately shortened, and if less than 30 amperes be discharged the time will be proportionately lengthened. An approximate rule to follow in calculating the capacity of an accumulator is to allow 6 ampere-hours for each square foot of positive plate surface.

The positive plates of an accumulator are all electrically connected together forming the positive terminal, and the negative plates are likewise connected together forming the negative terminal. The terminals of two or more accumulators may be joined in series or in multiple as with primary cells for increasing the total respective voltage or current developed. The connections between the accumulators in an electrical station are generally made by burning or fusing the lugs of the respective positive and negative plates to lead connecting strips, which method insures efficient and durable electrical contacts between them.

The electrolyte or acid solution contained in the vessel or tank for excitation is a mixture of pure sulphuric acid or oil of vitrol (H_2SO_4) and pure water (H_2O) in such proportions that the solution will have a specific gravity or density of 1.30 as measured with the hydrometer when the battery is fully charged and the solution at a temperature of 80 degrees Fahrenheit.

The chemical reactions that occur when the battery is charged and when it is discharged are as follows: When the charging process is completed the positive plate is covered with peroxide of lead (PbO_2), as previously stated, and the negative plate is covered with spongy metallic lead. During the discharge the lead at the negative plate combines with the sulphuric acid (H_2SO_4) and forms lead sulphate ($PbSO_4$) and hydrogen (H_2), the latter of which unites with the peroxide of lead (PbO_2) on the positive plate and forms lead oxide (PbO) and water (H_2O). The lead oxide (PbO) then combines with the sulphuric acid (H_2SO_4) and forms lead sulphate ($PbSO_4$) and water (H_2O). It is thus seen that considerable water is formed during the discharge, and this of course lowers the specific gravity of the solution. However, when the battery is again charged, the order just given is reversed and the conditions are practically the same as before.

When a new storage battery is installed and the accumulators are shipped directly from the manufacturers, the jars or tanks should be unpacked first, they should be thoroughly washed, their edges paraffined, and then placed permanently in position. The plates, which are usually boxed separately, may then be taken out if the acid solution is ready; if, however, the solution is not ready it is advisable to keep them well wrapped, as they are shipped dry and are easily injured by exposure. The cleaning of the plates must consequently be done before they are placed in the jars or tanks, and for

the purpose a pair of air bellows will be found very convenient in blowing out from the crevices without damage to the plates, any particles of foreign matter such as the material used in packing that may be lodged therein. Every effort should be made to have the working parts of the battery as clean as possible before pressing them into service, else short-circuits between the plates will be of common occurrence, and much trouble may be expected in consequence. In assembling the plates in the jars they should be so placed that the positive terminals and negative terminals of the accumulators are in such positions relatively to each other that connections may readily be made between them.

To prevent the neighboring plates of an accumulator coming in contact with each other, and thus causing an internal short circuit, separators consisting of sheets of wood and rubber are placed in each accumulator between the plates. The wooden portion of each separator consists of a thin web of selected wood, one side of which is flat and the other side grooved. The flat side is placed against the surface of the negative plate, while against the ribs formed by the grooves rests the rubber portion of the separator. The rubber is in the form of a thin perforated plate, and when this is placed against the wooden ribs previously mentioned, it serves to keep the plates the proper distance apart and at the same time permits a free circulation of the electrolyte through the channels formed by the wooden grooves. Although the wooden portion of the separator is not perforated, it is thin and absorbs enough of the acid to afford sufficient conductivity for the current.

As previously stated, the connections between the accumulators are generally made by fusing the leaden lugs of the plates to leaden strips; the strips have each a length equal to the widths of the accumulators, and they are composed of lead so that there will not be two different kinds of metals connected together, for under such conditions there would be a tendency for galvanic action to take place and impair the connections. In order to prevent sulphuric acid fumes from attacking the exposed terminals, these and other bare conductors in the battery room should be painted with a sulphuric acid proof paint such as can be made by dissolving shellac in wood-naphtha. Part of this paint may be colored red by adding vermilion and this may be used on all the positive battery terminals, while the remaining portion of the paint may be colored black by adding lamp-black and used on all the negative battery terminals. It will be found that, if the terminals be thus painted, no confusion will ever arise as their method of connection and many mistakes will thereby be prevented.

Thus far, both plates and separators are dry, but now the electrolyte is to be added. It should be given a density of about 1.17 by adding a certain quantity of water to concentrate sulphuric acid, and the mixture should not be poured into the accumulators until it is perfectly cool; after it has been introduced, the charging process should not be commenced for at least 12 hours in order to allow the electrolyte to thoroughly soak into the wooden separators. In diluting the acid, it must be remembered that the acid should be poured into the water, not water into the acid, as in the latter case explosions of more or less violence are liable to occur. Sufficient of the solution should be placed in each accumulator to fill them about one-half inch above the tops of the plates, and this distance should afterward be maintained constant in service.

The working parts of the battery being now in readiness the accumulators should all be connected in series with the source of current, the positive terminal of the battery being joined to the positive terminal of the charging generator or supply circuit and the negative terminal of the battery to the negative terminal of the generator or supply circuit. The generator supplying the charging current must necessarily be of the direct current type, and it should preferably be shunt wound.

Its rated electromotive force should measure at least 50 per cent. above the normal voltage of the battery to be charged, allowing 2 volts per accumulator as the normal voltage. If there is any possibility of the normal voltage of the battery when fully charged rising above the rated voltage of the charging generator employed an automatic switch should be connected in circuit between them so that any reversed current will operate this switch and open the circuit. A rheostat connected in the shunt field winding of the charging generator will be found very convenient for regulating the strength of the charging current, but if the wires of a supply circuit are used a rheostat connected in series with the battery and said circuit will answer the purpose.

The pressure of the charging current at the beginning of the charge need ordinarily be only about 2 or 5 per cent. above the normal voltage of the battery, its exact value being such as to maintain the passage of a constant current through the battery at all times during the charging process. The value of this current depends somewhat upon the design of the plates, and should in every case be obtained accurately from the manufacturers, but in general it is about 8 amperes per square foot of total surface of the positive plates undergoing charge. If the value of this current be exceeded, injurious results will follow, as will be shown later, and the plates will also suffer if the charging current be allowed to fall below one-tenth of its maximum value. As the charging process continues the back electromotive force of the battery increases, and in order to keep the charging current constant the applied voltage must be raised from time to time until, just before the charge is completed, it will probably be necessary to raise it nearly 40 per cent. above the normal voltage of the battery.

In some cases no means are at hand for keeping the charging current constant, and when the conditions are thus, the time required for the charge will be very much longer than would otherwise be the case. The reason for this is, that whereas at the start the current will be normal owing to the application of the proper voltage, it will afterward become less and as the number of ampere hours required to charge the battery is the same whatever be the value of the current the time must necessarily be increased when the charging circuit is below its normal value.

It is necessary to be particularly watchful of the internal temperature of the battery during the initial charge, and if this temperature rises to 100 degrees Fahrenheit the charging current should be reduced or stopped entirely until a temperature of about 80 degrees is again attained; in consequence, the initial charging rate should be made much lower than normal. During the first part of this charge the specific gravity of the electrolyte will fall somewhat below 1.17 but it will afterward increase, and the charge should be continued until the density is about 1.27 for the first charge, at which time the voltage of each accumulator should be approximately 2.4 volts. In following charges the process should be continued until the normal value of 1.30 be registered on the hydrometer scale and the voltage per accumulator be about 2.55 volts. Still another means is available for judging when a charge is nearly completed, and that is the electrolyte which at this stage assumes a milky appearance caused by the rising of gas bubbles through the solution. When this occurs the electrolyte is said to be boiling, although the boiling is not that due to a high temperature but to the peculiar appearance of the liquid. It may happen

that the accumulators do not all boil equally; this, however, need not cause apprehension unless in one or more of them there is no boiling whatsoever. An accumulator behaving in this manner should be disconnected from circuit for a time, during the discharge of the battery, so that it will average up well during the next charging process. Ideal conditions, it must be remembered, are attained only when all of the coils have the same amount of charge.

THE STORAGE BATTERY IN SMALL CENTRAL STATIONS.*

BY J. M. S. WARING.

Owing to the impossibility of drawing any distinct line separating storage battery practice in small central stations from that in the larger stations, and to the fact that many or most of the economies and advantages effected are common to all direct current stations, irrespective of their output, I have decided to deal with this subject in the following way:

First, to cite a battery application peculiar to small stations, and then to dwell briefly on the features common to all central stations.

In the first case the consideration will be that of a lighting station in a small village. In such cases it usually proves unprofitable to furnish continuous service throughout a 24-hour day, as the demand for current during the early morning hours and throughout the greater portion of the day would be so small that the additional shift of men required and the increased fuel consumption on the plant would prohibit the commercial success of the venture.

It is, however, true that the manager of a central station operating only a night schedule is greatly handicapped. In order to secure any great amount of residential lighting business continuous current must be supplied, as the owner of a residence would naturally demand light during all hours of the night, and would further probably demand fan service throughout the day during the summer months. If these facilities cannot be offered to the public the amount of business of the small central station is necessarily limited.

As an illustration of what has been accomplished along this line I might cite a case in actual practice where the conditions were as follows:

The plant I have in mind consisted of one 60 and one 120 hp. non-condensing engine, which in addition to driving certain machiney operated two 125 volt generators, one having a capacity of 20 and the other of 25 kilowatts, the two being operated in combination on a three-wire Edison system, with 220 volts across the outside mains. This plant had been operating and supplying a load concentrated within a very small radius. The maximum peak load of 150 amperes was on the station for about an hour and a half in the evening—that is from 6:30 until 8; it then gradually decreased to about 10 amperes at 11 o'clock at night, and at 12 the plant was shut down.

An opportunity arose for this plant to obtain the contract for city lighting, but the cost of the necessary transmission line, including poles, copper, etc., amounted to so much that the returns from the city lighting alone would not warrant the investment; however, it was obvious upon investigation that if a sufficient amount of residential lighting could be assured the investment would become a decidedly paying one, and with this in view a storage battery was installed. This installation made, the station continued to operate for the same number of hours daily. On account of the new business the load was materially increased. From 12 o'clock (midnight) until dusk in the afternoon the entire load was taken care of by the battery.

While this was a three-wire system with 220 volts across the outside mains, only a 110-volt battery was installed, for, during the hours that the battery was operating, the load was so light that by connecting the two outside mains together at the station the system could be operated by a two-wire 110-volt system, and even under these conditions, owing to the light load, the drop was considerably less than when operated as a three-wire system with the maximum load. In this case, there was an increase in load after the installation of the battery of about $66\frac{2}{3}$ per cent., and an increase in fuel consumption of only about 25 per cent., showing that the cost of fuel per kilowatt hour was decreased about $37\frac{1}{2}$ per cent., this decreased fuel consumption being due to the fact that the generator set, while operating with the battery, was run at a considerably higher percentage of full load than was the case before, the efficiency being correspondingly increased.

Another instance which occurs to me is similar to the above, with the exception that the plant supplied the adjacent district from a three-wire direct current system while in the outlying districts the load was on an alternating system. While this alternating load was extremely heavy during the peak it was very light during the day, consisting only of a small amount of fan service in the summer months. A battery was installed in this plant which furnished current directly to the direct current mains and at the same time operated a direct current motor running a small alternator so that the fans on the alternating current system could be operated.

These, and cases of a similar nature, are, of course, confined to very small plants.

Another application of the storage battery, which is irrespective of the size of the plant, is that of a battery operating in conjunction with a water power plant. A number of cases have come before the attention of the writer where there was sufficient water power to supply considerably more than the load existing during the greater portion of the 24-hour day, the peak load during the evening hours, however, being in excess of the capacity of the turbines. In this case the value of the battery is apparent, as the generators while carrying the day load are charging the battery at the same time, the battery assisting to the extent of its capacity during the peak, thus giving an increased station capacity which would otherwise be only obtainable by the addition of an auxiliary steam plant, with a correspondingly increased cost of operation, which would probably make the investment prohibitive.

There are a number of features which may now be briefly mentioned as being of interest to the central station manager, regardless of the size of the plant he is operating.

To the central station manager a minimum cost of production and transmission, allied with reliability of service, are essential. The consumer, however, demands that the latter item be not sacrificed in the pursuit of economy. Intermittent service results in a loss of business to the central station, and, while it may be difficult to compute the expense to which a lighting station is subjected by a 10 or 15 minute interruption, the official who receives the complaints of his customers fully realizes that a loss of revenue does result from frequent recurrences of this complaint. The storage battery insures increased economies of production and transmission, at the same time almost entirely preventing interruptions to service. A battery at the source of the direct current transmission—that is to say, in either a direct current power house or a rotary sub-station—will offset, in the first place, the installation of a corresponding capacity of boilers, engines and

*Paper read at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

generators. In the second case that of a rotary sub-station—in addition to this apparatus it will also offset a certain proportion of the static transformers and rotary equipment, with the cost of which apparatus that of the battery will compare favorably. It is of the greatest value as a reserve in either case, tiding over shut-downs occasioned by trouble on any of the apparatus just mentioned, or in the high tension line in the latter case. The battery, being ever present on the system, is readily available as a reserve.

It further obviates the necessity of carrying boilers under steam in anticipation of a peak load, thus insuring a decreased fuel consumption.

Another familiar application of the storage battery is that of placing it at the center of load on a direct current system of distribution. When the volume of business in a congested locality covered by a low tension system of transmission reaches a certain volume (and the more remote this locality from the central station the sooner this point is reached), the amount of copper required to care for the power from the central station necessitates an outlay tending to render this system of transmission prohibitive. By the installation of a battery of a capacity sufficient to care for a certain portion of the peak, the amount of copper between the central station and the center of load is decreased to such an extent that the battery investment is decidedly the preferable one from a commercial standpoint.

One of the more recent adaptations of the storage battery, and one whose importance will readily be recognized by central station managers, is its use in connection with the direct current exciters in alternating current power and lighting plants. With an installation of storage batteries floating at all times on the exciter bus, interruptions of current in the exciter circuit are practically obviated. Reduced fluctuations of the exciter voltage are assured, together with corresponding reductions in the alternating current voltage fluctuations. Where alternating current motors are used to drive the exciters, the battery also serves to supply field current when starting up the plant after a shut-down. An attractive feature in any battery installation is its adaptability to changes of conditions over a very wide range. Its capacity or voltage may be increased or decreased by varying the number of plates per cell or the number of cells in series without affecting in any way the original installation, thus obviating the necessity of anticipating any future increase in business.

It may be said in general that there are few direct current systems on which the service may not be improved, the liabilities of interruption decreased and the operating expenses minimized, by the use of a storage battery auxiliary.

MERSEY RAILWAY ELECTRIFICATION WORKING RESULTS.

(From our London Correspondent.)

A description of the electrical equipment of the Mersey Tunnel Railway appeared in ELECTRICITY for May 27, 1903. It will be remembered that after many years of hopeless struggling with the smoke problem in these tunnels, and the difficulty of obtaining satisfactory results with a system of steam locomotion whose operating costs amounted to 90 per cent. of the gross receipts, electric traction was hailed as the only possible chance of salvation and by making certain financial arrangements with the Westinghouse Company the conversion was carried out, and the line opened for public service on May 3, 1903.

Electrical engineers have naturally been following the working of the system with considerable interest as it is the first English system to complete the change over from steam to electricity, and the results which have followed upon the first ten months' running are now being studied closely. Such data as is interesting from an engineering point of view was disclosed to a meeting of the Manchester Institution of Electrical Engineers on March 1 by Mr. H. L. Kirker in a paper on "The Mersey Railway—Multiple Control." Before passing to a review of these results we should like to incidentally mention one point in connection with the conversion which may serve to illustrate something of the sort of work that the contractors had to do. The work on the permanent way in the tunnel was of such a disagreeable nature that difficulty was experienced in retaining the men. The actual working hours were from 12:30 till 4:30 A.M., except on Sundays, when they were extended to noon, but the air was never free from smoke. The greater part of the cable work was in the ventilation headings, and here there was, in addition to the smoke, a 17 years' accumulation of soot to contend with.

The steam plants which formerly did service for ventilating the tunnels were suppressed, and two 12 ft. and one 5 ft. motor-driven fans installed at stations, and generally speaking the two former are quite sufficient to ventilate the tunnel quite satisfactorily. Each 12 ft. fan, in normal operation, moves 65,000 cubic feet of air per minute with a consumption of 24 hp.

At the power station the mechanical coal handling arrangements, the feed water system, and the storage battery, have proved important elements in the production of cheap power; further, an efficient application of this power has been secured by the location of the power house at a point where the losses in conductors and the investment in cables are at a minimum, and by the use of multiple unit train control.

A comparison of the working results for the period mentioned, with the original engineering estimates, was made by Mr. Kirker. Taking first the cost of ventilation. This under steam conditions cost on the average more than £2,400 per half year; but with electric traction it is now less than £200 for a half year, and this is well within the engineers' estimate. As to schedule speed, with steam the rate was 15 miles per hour, but electric traction was laid out on a basis of 20 miles per hour, and this has been attained. With the steam locomotives the train mileage was less than 6,000 per week, but during the last quarter of 1903 the electric trains lacked but 40 miles on an average of 15,000 miles per week. At this rate the total mileage for the year will considerably exceed the original estimate. It was estimated that the coal consumption would not exceed 4 lbs. per kw. hour (average) at the switchboard. The average for the last quarter of 1903 and the first six weeks of 1904 is said to be under the 4 lbs. The consumption of energy for a loaded three-car train was estimated not to exceed 9.25 kw. hours per train mile; for the last quarter of 1903 the actual figure was less than 9. As regards the cost of operation per train miles, it was estimated that the power house expenses, the cost of power for operating and lighting trains, the maintenance of electrical equipments, cars and collector rails, would not exceed 6.75d. per train mile for an average train 230 ft. long, and weighing 105 tons, including motors. The actual figure for the last quarter of 1903 falls below this estimate.

The corresponding cost per steam train 200 ft. long and weighing 77 tons, exclusive of locomotive, but working at a schedule speed of 15 miles per hour instead of 20, exceeded 11d. per train mile. It required an 80 ton locomotive to haul the 77 ton steam train.

The total power station cost made up of

maintenance and operation (coal, water, oil, waste, sundries, and labor) did not exceed .35d. per kw. hour during the last quarter of 1903.

These results are considered to show that the original engineering estimates have been practically fulfilled.

What effect the electrification has had in bringing back traffic which had been lost through the former unsatisfactory system is not yet known. This will be announced shortly. In the early months of electrification the increased traffic was not so great as had been expected but things are thought to have improved considerably as the improvements in the system have become properly known and appreciated.

National Electric Light Association Notes.

Mr. Charles L. Edgar, president of the National Electric Light Association, was in New York several days last week looking after association affairs. President Edgar was accompanied by past president James I. Ayer, whom he has been fortunate enough to induce to act as chairman of the entertainment committee of the 27th Convention, to be held in Boston, May 24–27.

The entertainment committee, among its other duties, will have charge of assigning rooms at the Vendome, which is to be the headquarters of the association, and particulars regarding rates, etc., will be issued very soon. As many delegates prefer to stop at a smaller or quieter hotel than that selected for convention headquarters, arrangements will be made by which they also can secure through the committee such accommodations as they prefer. In fact, hotel arrangements promise to be more systematic and satisfactory than they have ever been before.

The preliminary questions for the question box of this convention have just been sent to members. This list is nearly twice as large as the completed list for last year's convention, and there is every indication that the question box for the coming convention will be not only the largest but the most systematic and comprehensive ever presented by the association.

Mr. C. O. Baker, Jr., for so many years the popular and efficient master of transportation for the National Electric Light Association, has resigned from that position. Mr. Baker expects to be in Europe at the time of the Boston meeting, and feels that he should not continue in the office unless he can personally attend to the duties connected with it. President Edgar has appointed Mr. George F. Porter to succeed Mr. Baker. Mr. Porter had charge of transportation matters before he became secretary of the association, and organized special trains for the Detroit convention, February, 1887; the Chicago convention, February, 1889, and the Kansas City meeting, February, 1890. During the ten years that he was secretary he of course had more or less to do with transportation arrangements, and being very popular with the railroad people as well as with the delegates to conventions, his appointment is another instance of President Edgar's good judgment in selecting men to work for the welfare of the association.

New York Electrical Society.

In response to an invitation addressed to him by a number of his friends, members of the Society and of the American Institute of Electrical Engineers, Mr. Oscar T. Crosby, E.E., the distinguished engineer and explorer, has consented to deliver a lecture entitled "Things Seen in Turkestan and Thibet," at the lecture room of the American Institute, 19 West 44th street, this (Wednesday) evening, March 23, at 8 o'clock.

American Electrochemical Society.

The following papers will be read at the Washington, D. C., meeting to be held April 7, 8, and 9:

"The Composition and Resolution of Voltages," by Dr. J. W. Richards; "Notes on the Industrial Electrolysis of Water," by W. S. Landis; "Standard Cells," by Dr. F. A. Wolff; "Electric Smelting Experiments for the Manufacture of Ferro-nickel from Pyrrhotite," by Ernst A. Sjostedt; "A Contribution to the Study of the Electric Arc," by Dr. William S. Weedon; "The Energy of Ions," by Dr. L. A. Parsons; "Some Experiences in Copper Precipitation," by Hermann Poole; "The Preparation of Materials for Clark and Weston Standard Cell," by Dr. H. S. Carhart and Dr. G. A. Hulett.

A large number of papers besides the above will be read.

Society of Chemical Industry.

The next meeting of the New York Section will be held at the Chemists' Club, 108 West 55th street, on Friday evening, March 25. The following papers will be read: "Analysis of Jalap," by Russell W. Moore; "Acetic Acid in Acetate of Lime," by Albert G. Stillwell; "The Preparation of Cotton Fiber for Surgical Uses" (illustrated by lantern slides), by F. B. Kilmer, and "Cupellation of Platinum," by W. J. Sharwood.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 15, 1904.

Electric Railways and Appliances.

754,406. Electrically-Operated Stopping Means at Railway Danger Signals. William L. Adamson, Philadelphia, Pa. Filed June 12, 1903.

754,565. Electric Railway. Rudolf A. E. Huber and Hans H. C. Behn-Eschenburg, Zurich, Switzerland, assignors to the Maschinenfabrik, Oerlikon, Switzerland. Filed Dec. 23, 1901.

754,652. Trolley-Hook for Manipulating Self-Loading Grabs. Frank K. Hoover and Arthur J. Mason, Chicago, Ill. Filed May 21, 1903.

754,778. Trolley-Wheel Retainer. James A. Kilpatrick, Niles, O. Filed Dec. 19, 1903.

754,832. Electric-Railway Plow. John H. Akers, Washington, D. C. Filed Aug. 8, 1903.

Electric Lights and Appliances.

754,694. Electric Pocket-Lamp. Angelica E. Post, Boston, Mass. Filed Dec. 30, 1903.

754,762. Electric-Socket Support. Edwin R. Gill, New York City. Filed March 14, 1902. Renewed Dec. 23, 1903.

Electrical Machinery and Apparatus.

754,496. Limiting Device for Electric Circuits. Charles W. Potter, Denver, Col. Filed Feb. 10, 1902.

754,505. Automatic Circuit-Breaker. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical & Manufacturing Company. Filed June 18, 1903.

754,638. Transmission-Gear. Patrick H. Brennan, Syracuse, N. Y. Filed Dec. 21, 1903.

754,666. Induction-Coil. Reuben Miller, Jr., Pittsburg, Pa. Filed Jan. 7, 1904.

754,689. Electrical Selective Apparatus. Frank D. Pearne and Charles L. Krum, Chicago, Ill., assignors to the Pearne Electric & Manufacturing Company, same place. Filed Feb. 3, 1902.

754,748. Electric Stop-Motion for Warping-Machines. John Cocker and Charles Denn, Philadelphia, Pa. Filed Jan. 30, 1902.

754,804. Speed-Regulating Magnetic Clutch. Charles A. Pratt, Oakpark, Ill. Filed Dec. 7, 1903.

754,863. Electrical Plug and Receptacle. Gilbert W. Goodrich, Bridgeport, Conn., assignor to the Bryant Electric Company, same place. Filed Oct. 9, 1903.

Telephones and Telephone Apparatus.

754,457. Telephonic Relay or Repeater. Isidor Kitsee, Philadelphia, Pa. Filed July 7, 1899. Renewed April 25, 1902.

754,556. Telephone Receiver Support. Harry L. Goodwin, Kansas City, Mo., assignor of one-half to Charles N. Lavery, same place. Filed May 25, 1903.

754,646. Antiseptic Telephone Mouthpiece. William M. English and Arthur H. Ten Broeck, San Francisco, Cal. Filed April 27, 1903.

Miscellaneous.

754,410. Electric Time Alarm. Emil M. Benesch, Denver, Col. Filed March 7, 1903.

754,429. Means for Electrical Distribution. John L. Creveling, New York City. Filed May 10, 1901.

754,451. Electrical Water Heater. Harry M. Hill, St Louis, Mo., assignor to the Hill Electric Manufacturing Company, same place. Filed June 1, 1903.

754,465. Automatic Electric Heat Regulator. Daniel N. Leib, Elkhart, Ind., assignor to the Automatic Heat Regulator Company, same place. Filed April 10, 1902.

754,534. Thermostatic Gas Detecting Means. James E. Baldwin, East Williston, N. Y. Filed Sept. 10, 1902.

754,622. Electric Clock. David W. Thompson, Chicago, Ill. Filed Dec. 5, 1895.

754,637. Electromagnetic Gun. Kristian Birkeland, Christiania, Norway. Filed Jan. 2, 1902.

754,656. Electric Furnace. Charles A. Keller, Paris, France. Filed Jan. 17, 1902.

754,660. Rheostat. Lamar Lydon, New York City, assignor to the National Battery Company, Buffalo, N. Y. Filed Aug. 8, 1902.

754,681. Electromagnetic Device. Eugen K. Muller, Zurich, Switzerland. Filed Sept. 20, 1902.

754,692. Rheostat. Claude R. Pitrat, Amsterdam, N. Y., assignor to the Magneto Electric Company, Incorporated, same place. Filed Aug. 8, 1903.

754,756. Process of Separating Ores from Magnetic Gangue. Thomas A. Edison, Llewellyn Park, N. J. Filed May 29, 1903.

754,858. Storage Battery Tray. Thomas A. Edison, Llewellyn Park, assignor to the Edison Storage Battery Company, Orange, N. J. Filed Nov. 28, 1902.

754,859. Reversible Galvanic Battery. Thomas A Edison, Llewellyn Park, N. J., assignor to the Edison Storage Bttery Company, Orange, N. J. Filed Nov. 28, 1902.

THE TELEPHONE WORLD.

Higher Telephone Rates in Kentucky.

Beginning with the 1st of April the Fayette Home Telephone Company of Lexington will increase its rates from $2.50 per month for business houses to $3.50, and from $1.50 for residences to $2.50 per month. The Fayette Fiscal Court lately canceled the restriction in the franchise which bound the company to give a service of $1.50 for private residences and $2.50 per month for offices. Some weeks ago the attorneys of the company secured the passage of an ordinance in the city council securing the same privilege from the city. It is predicted that this will put an end to the liberal rates for telephone service in Fayette County, if not in Central Kentucky.

The Home Telephone Company, recently organized by the farmers and business men of Oldham County, Ky., has a large force of men at work hauling poles from Beard to be used in the construction of its main line, which is to run via here to Middletown, where it will connect with the Home Telephone Company's line.

A quarterly dividend of 1¼ per cent. on preferred stock was lately announced at the annual meeting of the stockholders of the Iowa Telephone Company held in Davenport before moving to Des Moines, where in the future the headquarters of the company will be located.

The Kuntz International Telephone Company of Washington, D. C., capitalized at $10,000,000, has the following incorporators: J. W. Kuntz, J. A. Thompson, Harvey T. Winfield, Joseph A. Roth and Charles W. Fitts.

The Hermon & St. Augustine Telephone Company of Hermon, Ill., capitalized at $10,000, will build and operate a telephone system. W. A. Bogan, George M. Brown and George Castle are the incorporators.

The articles of incorporation of the Iowa Telephone Company of Tama were lately filed with the Secretary of State. The capital is $15,000 and incorporated by C. W. Smith and L. P. Crittenden.

The Farmers Co-operative Telephone Company of Hendricks County, Ind., capitalized at $10,000, has as directors Samuel Jordan, Abraham Hoadley, Alva Ross, G. L. Christie, William Moon, John Ules and J. T. Jones.

The Chicago Telephone Company is to erect an exchange and office building on Washington street. The company has a 99-year lease at an annual rental of $8,000. The building will be 16 stories, and will cost about $600,000.

The Riverton Telephone Company has been organized at Sharptown, Neb., and will erect a telephone line from Mardela Springs via Riverton to Sharptown.

The farmers in the southwestern portion of Fillmore County, Neb., are constructing an Independent telephone line.

New Rochelle, N. Y., is to have a new telephone system installed about May 15

Five-Cent Telephones to go Out of Service.

Representatives of the Bell Telephone Company, says a New Jersey paper, are informing persons who have what are known as "five-cent-a-call 'phones" that the present system of payment for such services is to be discontinued and that after April 1 such telephones will cost the subscriber $1 a month.

It has been the plan in the past that such telephones were paid for by the call and at the rate of five cents for each use. By the new plan the service will cost $12 a year. This condition will be applicable to those patrons who have these 'phones in their homes at present.

It is the purpose of the company in making this change to decrease a great amount of detail work at the central office. Under present conditions each call has to be recorded and at the end of the month slips made out showing to the subscribers the number of calls during the month. This method is a long drawn out one and is not considered practical.

The Western Dixie Telephone Company has been organized at Vale, Tenn., with E. B. Simmons, president; Dr. Florence, vice-president and A. N. Presson, secretary and treasurer. This company has lines running from Camden to Huntington, with a number of subscribers at both places, and several branch lines, giving connection with all places along and near the main line. It is the intention of the promoters of the company to obtain a charter at an early date and do a general telephone business.

News from Knoxville, Tenn., states that the fight brought on by the merchants some months ago against the East Tennessee Telephone Company has now practically been abandoned, and the company is restoring its service in a large number of business houses. Manager Williams says that the only difficulty experienced at present is that of installing the instruments as rapidly as the subscribers desire. It was only on the question of an advance in the price of 'phones that the fight on the company was made.

A charter was recently issued in Charleston, W. Va., to the Wheeling & Pittsburg Telephone Company of Wheeling, to construct and operate a telephone line. Its capital stock is $100,000. Incorporators: J. A. Howard, J. P. Young and F. C. Handlan, of Wheeling; R. C. Hall and J. G. Plant, of Pittsburg.

A telephone company has been organized at Mexico, Ind., with a capital stock of $2,000. The town will be supplied with 'phones, and communication established with neighboring towns. The officers are: Lewis Bond, president; W. E. Fisher, vice-president; Leroy Graft, secretary, and J. T. Hood, treasurer.

The net output of the American Telephone & Telegraph Company decreased 9,347 instruments for the month of February, making a decrease of 42,108 instruments since December 20 last.

Messrs. Denton and Newbern are putting in a telephone exchange in Broxton, Ga., and will have it in operation by April 1.

Missouri Has New Telephone Company.

The Missouri River Telephone Company, capital stock $150,000, half paid in, lately filed articles of incorporation with the county recorder. The company is composed of J. E. Zeluff, of Kansas City, who owns 1,000 shares; Walter S. Dickey, of Kansas City, 50 shares; W. T. Rankin, Tarkio, 200 shares; Frank S. Travis, and John R. Stafford, both of Tarkio, each 100 shares, and Ralph O. Stauber, St. Joseph, 50 shares.

The board of directors is composed of Walter S. Dickey, W. T. Rankin, Frank S. Travis, John R. Stafford and Ralph O. Stauber. Mr. Stauber is the agent of the company, the headquarters of which are to be maintained in St. Joseph.

A new protective device known as the phonalarm is so arranged in conjunction with the telephone circuits that when a door or window which is provided with the alarm is opened a signal is transmitted to the telephone exchange and the police headquarters are therefrom communicated with. The company's arrangement is so delicate that when a pane of glass in a window is broken the alarm is transmitted

The Independent companies of Vermont recently held a meeting at Hardwick. Twenty officers were present, representing six companies. Arrangements were made for the construction of a first-class trunk line from St. Johnsbury by Danville and Hardwick to Montpelier and so arranged that Montpelier can be called from St. Johnsbury direct.

At a recent meeting of the Lake City, Minn., council a resolution was passed to place before the voters the proposition of the municipal ownership and operation of a telephone system within the corporate limits of that city. It will be voted on at the election to be held on April 5. The city owns its waterworks and electric lighting plant. The telephone system now in operation is owned by private parties, but is being operated without a franchise from the city council.

A recent announcement from Cincinnati, O., says that the Norwood Citizens' Telephone Company has been granted a 25-year franchise by the Norwood council. This action was not taken without considerable opposition, and it was adopted by a very narrow margin. One of the immediate effects of the granting of this franchise will be to bring the Independent telephone companies a step nearer to Cincinnati.

The Farmers' Telephone Exchange Company of Caldwell, O., was lately incorporated at Columbus, O., with a capital stock of $10,000. The line will run from Caldwell to Cambridge, Zanesville, McConnelsville, Marietta and Woodsfield.

Telephone Incorporations.

The Sherburne Telephone Company, Sherburne, N. Y. Capital stock, $10,000. Incorporators: Jesse H. Shepard, Frederick I. Shepard and George L. Shepard.

The Troy Telephone Company, Troy, Ill. Capital stock, $10,000. Incorporators: J. H. Steinhaus, J. W. Gornet and Chris Busse, Jr.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Addison, O.—This town may be lighted with electricity, the current being secured from Springfield.

Albany, N. Y.—Members of what is known as the Bolton Road Colony, who own summer homes along the west shore of Lake George, have petitioned the Hudson River Water Power Company to string its wires along the shores of the lake to furnish light and power to run electric launches and for other purposes.

Anderson, Ind.—Commissioners of the municipal electric light plant announce that on April 1 a 30 per cent. reduction will be made in rates for electric light service here.

Baltimore, Md.—The Maryland Telephone & Telegraph Company proposes to enter the field as a competitor to the United Electric Light & Power Company for the electric lighting business of this city.

Bartlett, Tex.—It is reported on good authority that capitalists will submit a proposition to establish an electric light plant to supply this place, Granger and Holland with light. The people here favor the scheme.

Carmi, Ill.—The matter of purchasing an additional engine and dynamo for the electric light plant has been referred to the committee on electric lights.

Chesterfield, Ind.—A system of waterworks and an electric light plant will be added to the camp grounds this season.

Colima, Mex.—The city council has approved the project submitted by Messrs. Ugary and Garcia for the installation of an electric light plant here.

Duquoin, Ill.—The city council is contemplating the erection of an electric light plant.

Georgetown, Ill.—W. C. Dukes and Edward Cooley have been given a 20-year franchise for an electric light plant for this city. The plant is to cost $10,000, and have 1,200 lights at the start.

Hancock, Mich.—The citizens voted favorably on the proposition to build a municipal electric light plant next month.

Harmon, Ill.—The people here are considering the advisability of installing a public electric lighting plant.

Havana, Ill.—A special election will be held here in April to vote whether or not the city shall own and maintain an electric lighting plant.

High Springs, Fla.—The citizens may soon vote on a bond issue for an electric light plant and waterworks.

Kissimmee, Fla.—It has been recommended that this city install a new 90 kw. alternator and 150 hp. engine in its electric light plant; also a new wire system and series arc system is recommended.

Lakeview, O.—Pearl Kearns has secured the contract for putting in an electric light system here.

Linton, N. D.—This town may get an electric lighting plant.

Monclova, Mex.—A company has been organized here in the State of Coahuila, with Jose M. Tejada as president, to put in an electric light plant, the subscribed capital being $40,000.

New Castle, Wyo.—The Cambria Fuel Company will construct a line between Cambria and this place, and supply this town with electric light and power from the plant at the Cambria mines.

New London, Wis.—This city has purchased from local capitalists the municipal electric lighting plant. Extensive improvements will be made. The city has borrowed $10,000 from the State.

Newtown, Pa.—After four months' consideration the borough council has decided in favor of lighting the town by electricity and has granted a three-years' contract to the Newtown Electric Railway Company.

Ocilla, Ga.—Bids are being asked for installing an electric light system. J. G. Walker is mayor. The amount of $5,000 is reported available.

Papillion, Neb.—The installation of an electric plant is being discussed here.

Pinckneyville, Ill.—The electric light plant here was lately destroyed by fire, causing a loss of $10,000.

Princeton, Ind.—The electric light plant here is to be remodeled and enlarged.

Rathdrum, Ida.—M. D. Wright and Mr. Richards, of the Washington Power Company, are looking over the town and trying to make arrangements for the installing of an electric light plant.

Sayre, Okla.—This city is to have an electric light system soon.

Sheboygan, Wis.—This city recently purchased the electric light and power plant.

Tepic, Mex.—The city council is seriously considering the project to establish an electric light plant.

Vernon, Tex.—The electric light plant was destroyed by fire a short time ago. The property was owned by H. D. Rockersmuth and was insured for about half its value. The estimated loss is about $3,500.

Wayland, Mich.—This city is to have an electric lighting plant. The council lately granted a franchise to Walbrecht & Duel, who will soon commence work.

West Bay City, Mich.—The council has decided to submit at the next election a proposition to bond the city for $60,000 for electric light improvements.

STREET RAILWAYS.

Alamo, Tenn.—Rush A. Persons and Sam Wallace have just returned from their trip through the country along the line of the proposed electric line to the Mississippi River and state that it will certainly go through. A meeting of the citizens of this place was held on their arrival and $50,000 was subscribed for the line.

Cairo, Ill.—The Cairo Electric & Traction Gompany has petitioned for the right of way along the county road.

Chicago, Ill.—The car barn of the Chicago Union Traction Company was destroyed by fire last week. About 600 summer cars stored in the building were burned. The loss is estimated at $150,000.

Cumberland, Md.—Work has been begun on the new electric car line to connect Westernport with Keyser, W. Va., and the road will be pushed rapidly to completion. The line will connect with the Cumberland & Westernport Electric Railway.

Evansville, Ind.—Judge W. N. Harding, of Indianapolis, representing capitalists of that city, has been here with F. J. Sholtz to inspect several routes for the proposed electric interurbans from this city to the surrounding towns.

Far Rockaway, N. Y.—A new trolley line is to be constructed by the Long Island Railroad Company along the Boulevard, from here west to the newly developed section known as Bell Harbor. The object of this is to divert traffic from the steam tracks, over which the Rockaway trolley line now runs.

Liberty, Ind.—A 50-year franchise has been granted to the Interstate Traction Company to extend the line from Dayton and Camden O., through this town, to Connersville. The company also contemplates the extension to Chicago through a portion of the State now traversed by electric traction roads. It is promised that this division of the road will be completed for operation by December of 1905.

Meriden, Conn.—The Wallingford Tramway Company holds a franchise to build a trolley line from here to Montowese.

Mineola, N. Y.—The Mineola, Roslyn & Port Washington Traction Company will soon begin work on the construction of its lines.

New York City.—The New York City Street Railway Company and the Brooklyn Rapid Transit Company have agreed to co-operate in operating cars over the Williamsburg Bridge.

Peoria, Ill.—The Illinois Valley Traction Company has decided to build its interurban road from Utica west.

Penn Yan, N. Y.—The Lake Keuka & East Side Electric Railway Company will apply for a franchise to construct a road from this city to Keuka.

Richmond, Va.—The Seaboard Traction Company has been incorporated with a capital of $250,000. L. R. Britt, president.

Spokane, Wash.—The Washington Water Power Company is said to have secured the old Seattle, Lake Shore & Eastern right of way from here to Medical Lake and will build an electric line connecting the two places.

POWER PLANTS.

Blue Ridge, Ga.—The Blue Ridge Electric Light & Power Company is stated to be preparing to erect a power plant.

Helena, Mont.—The Ox Bow Power Company, recently incorporated in South Dakota, has under contemplation the construction of a dam across the Missouri River below this city, and the generation of electric power to be conveyed to Helena, Butte, Anaconda and other points. About $750,000 will be expended.

Vineland, N. J.—Local parties are discussing a project to utilize the Maurice River water power for generating electricity.

BIDS WANTED.

Hamilton, Ont.—Sealed bids in accordance with plans and specifications to be seen at the office of the Hamilton Cataract Power, Light & Traction Company, located at 128 King street, East, of which William C. Hawkins is general manager, will be received until March 31, for the construction of an enlargement of the hydraulic system.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12⅝@12⅞c.; casting, 12½@12¾c.

The Chicago City Council has granted a franchise extension to the City Railway Company until January 1, 1905.

The stockholders of the Philadelphia Electric Company will hold its annual meeting in Camden, N. J., on April 13.

The General Electric Company has declared the regular quarterly dividend of 2 per cent., payable April 1 to stock of record March 24.

The Keystone Telephone Company of Philadelphia (independent) states that it has installed over 1,200 new telephones since January 1.

The Savannah (Ga.) Electric Company has declared a regular semi-annual dividend of $3 per share on the preferred stock, payable April 1.

The annual meeting of the stockholders of the American Telephone & Telegraph Company will be held at 15 Dey street, New York, on March 29, at noon.

The Rochester (N. Y.) Railway Company has declared the regular quarterly dividend of 1¼ per cent. on its preferred stock, payable April 1.

The Middlesex & Somerset Traction Company, which has 50 miles of track, has been sold to the Public Service Corporation of New Jersey for $1,250,000.

Directors of the Bell Telephone Company of Philadelphia have declared the regular quarterly dividend of 1½ per cent., payable April 15 to stock of record April 5.

At the annual meeting of the stockholders of the American Light & Traction Company, held in Jersey City on Monday, the retiring board or directors was re-elected.

It is understood that the directors of the Welsbach Company are seriously considering the question of removing its plant from Gloucester, N. J., to Buffalo, N. Y.

A postponed meeting of the United Traction Company of Albany, N. Y., will be held April 2, to consider the question of making a new mortgage and issuing bonds for $6,500,000.

The Connecticut Railway & Lighting Company has filed a mortgage for $1,000,000 in favor of the Central Trust Company of New York to secure an equal amount of bonds.

The Mexican Light & Power Company, which is controlled by Canadian capitalists, is said to be about to acquire the Federal Street Railway in Mexico City for $18,000,000.

The Heat, Light & Power Improvement Company of America was incorporated at Albany on Monday with a capital of $600,000. The office of the company will be in New York city.

The directors of the Metropolitan Street Railway Company of New York have declared a regular quarterly dividend of 1¾ per cent., payable April 15. Books close March 24 and reopen April 16.

Of the nine street railways in New York State which declared dividends during the last year the Schenectady Company shows the largest gross earnings per car mile, but the expenses were comparatively large.

The New York Railroad Commission has authorized the Albany & Hudson Railroad Company to issue an additional $100,000 under the mortgage heretofore consented to by the board. For new buildings and for improvements in construction and extension a large sum has been set aside.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Mar. 21
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	143
Metropolitan Street Railway	111¾
Metropolitan Securities	79⅝
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	43
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	63
Philadelphia Traction	97¼
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	139½
West End Street, com	92½
do. do. do. pref	109½
Chicago.	
City Railway	161
North Chicago	87
Union Traction, com	6
do. do. pref	32
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	21
do. do. pref	56
Electric Lead Reduction	⅞
Electric Vehicle, com	7
do. do. pref	12
Westinghouse, com	164
do. pref	194
General Electric	168
Boston.	
Edison Electric Illuminating	234
General Electric	168¼
Massachusetts Electric Companies, com	19
do. do. do. pref	73
Westinghouse Electric & Mfg., com	78
do. do. do. pref	89
Chicago.	
Chicago Edison	152½
National Carbon, com	28½
do. do. pref	98
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	58
do. do. pref	58
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	124
Western Telephone Company	9
New England Telephone Company	119
New York.	
American Telegraph & Cable Company	84¾
Commercial Cable Company	191
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88
Miscellaneous.	
Chicago Telephone Company	118
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	34
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

A Bill to Regulate Electric Wiring.

A bill introduced into Congress some time ago for the regulation of electric wiring in the District of Columbia has passed the Senate and is now in the hands of the Committee of the District of Columbia on the House side. This bill makes it unlawful for any person to act as an electrical wiring contractor or to engage in electrical construction or installation, who has not been licensed or is not working under the supervision of some person so licensed. This, however, shall not be construed as applying to the public buildings and grounds, or to the generation of power by incorporated companies engaged in the production of electrical current for public service or use.

The bill makes it unlawful for any person, firm, or corporation to operate, as owners or lessees, any electrical generating plant in the District without first securing a permit to operate same, and it shall also be unlawful for any person as an employe of any person, firm or corporation to operate any electrical plant or machinery for the generation or utilization of electricity for light, heat or power without first having obtained a license.

The commissioners would be authorized, in the event that the bill is enacted, to appoint an electrical board of three members, at least two of whom shall have knowledge of electrical lighting and power, one of the three to act as secretary and chief inspector of electrical work, the compensation to be two hundred dollars per annum, the men composing the board to be already in the employ of the District. The commissioners would be expected to prescribe the necessary rules and regulations, and all wiring and apparatus for the utilization and production of electric current for lighting, heating and power, and the installation thereof to be subjected to such tests as the commissioners may prescribe.

The commissioners, upon the recommendation of the board, would have the right to make such rules and regulations respecting the production, use, and control of electricity in the District of Columbia not conflicting with existing laws, as would best afford safety and convenience to the public, and they would also be authorized to prescribe fees for the issuing of licenses and for the examination of electrical wiring, machinery, and appliances; it would also be the duty of the board to examine all applicants for licenses as electrical contractors and report the results to the commissioners. Before obtaining a license a contractor would be expected to file in the office of the commissioners a bond with satisfactory sureties in the sum of $2,000, for the faithful performance of all work which he might undertake, so that it would be in conformity with the requirements of the commissioners. Such applicants would not be less than 21 years of age, and the term "electrical contractor" would include all persons putting in place wiring and apparatus necessary for the production and utilization of electrical current for lighting, heating or for power. The fee for a license as an electrical contractor would be $5 per annum.

A further provision is to the effect that any person who shall knowingly employ an electrical contractor who has not been regularly licensed would be subject to punishment by a fine of not less than $5 nor more than $100 and in default of payment shall be confined in the workhouse for a period not exceeding six months. Any persons engaged in the business without a license shall be subject to a fine of not less than $5 for each and

every offense, or by imprisonment for not exceeding one month.

The commissioners would be authorized to appoint an electrical engineer at a salary of $2,500 per annum, to be an expert electrician possessing a thorough knowledge of the most improved methods for the production, use, and control of electricity, and with the necessary executive ability to satisfactorily fulfill the requirements of his office. The assistant would receive $2,000 per annum; two electrical inspectors would also be appointed at salaries of $1,200.

It would be unlawful for any person, company, or corporation generating current for electric light, heat or power in the District to connect its system and furnish current for electrical purposes to any building or premises, the wiring of which shall not have been inspected by the chief inspector of electrical work. The bill is very full in all its provisions for accomplishing the purpose in view.

* * *

To Analyze Coal. The Secretary of the Treasury has asked for an appropriation of $30,000 to be used at the Louisiana Purchase Exposition under the supervision of the Director of the U. S. Geological Survey, for the purpose of analyzing and testing coals and lignites of the United States, in order to determine their fuel values and the most economic method for their utilization for different purposes; this is along a line of work and investigation that has been given consideration for some time past by the Geological Survey.

In the tests which it is proposed to make at the Louisiana Exposition those for actual fuel values will be made in connection with a battery of six 100 hp. boilers, used for the purpose of furnishing power to the indoor and outdoor exhibits of the mining department. All of the coal used in making these tests will be carefully weighed before being fired into the furnaces, and the amount of steam developed and the power utilized carefully ascertained through a uniform period of time and under uniform and actual working conditions. The coal so used will be carefully sampled, so as to obtain an average representative specimen for chemical analysis and physical examination, and this specimen will be sent to the Survey laboratories in Washington for this purpose.

The coking qualities of the samples furnished will be tested in a plant of ten Otto-Hoffman by-product recovery ovens, whereby not only the yield and quality of the coke produced will be ascertained, but also the amount of by-product obtainable from each kind of fuel. These by-products will include gas, coal tar and ammonia. Of most vital importance in connection with these series of tests will be the ascertaining of the amount of creosoting oils which may be obtained from the coal-tar products. The demand for creosoting oils in the treatment of railway ties, telegraph poles and other wood exposed to the combined action of air and moisture is of vital importance in the development of railway construction in the United States at the present time.

All the machinery and lignite materials to be used in making these tests are to be furnished free of all expense to the Government.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

"Cloudborn electric wavelets to encircle the globe" is Mr. Nikola Tesla's latest dream, and he says humanity will be like an antheap stirred up with a stick —"when his first plant is inaugurated."

As was to have been expected a representative of the Brooklyn Rapid Transit Company, at a hearing before the Railroad Committee of the Assembly in Albany, N. Y., protested against the passage of the third rail protection bill, referred to editorially a short time ago by ELECTRICITY. The representative declared that the company was ready to accept any practicable plan of protecting the lives of its employes and passengers, but affirmed that no invention had yet been made which would guard against the danger or would not in point of fact increase it. The gentleman in question is to a certain extent right. There is no scheme that a railroad company could adopt to lessen or eliminate the danger of the third rail *that would not cost money.*

It was announced Friday by the General Electric Company that the annual meeting of the directors of the company will be held in Schenectady, N. Y., on May 10, at noon, and there will be a meeting of the stockholders for the purpose of authorizing an increase of $3,325,000 in the capital stock. It was also given out that E. W. Rice, Jr., has been elected a director in the place of the late William C. Whitney.

Mr. James I. Ayer, chairman of the Committee on Relations with Kindred Organizations of the National Electric Light Association, announces that arrangements have been made by which the association will have permanent headquarters at the St. Louis World's Fair, consisting of a railed inclosure furnished with chairs, a convenient desk, stationery, etc., for the use of its members.

It is officially announced that the directors of the Cunard Line have decided to adopt turbine engines for the new steamers to be built under agreement with the British Government.

Sixteen cancer patients were recently treated with radium in the London Hospital, but the only favorable result has been the cessation of pain in some cases, while in others the patients complain of an increase in the pain. The experiments have stopped.

Mayor McClellan on Saturday last officially opened the new garbage crematory at the foot of West 47th street, New York. It is claimed that by the establishment of crematories the city saved $67,000 a year. Waste paper, boots, shoes, etc., are separated from the garbage and sold at a profit. The rest of the refuse is burned in furnaces beneath a plant of boilers which furnish power sufficient to operate 3,000 16-cp. incandescent lights.

The city of Pittsburg, Pa., "fathers" are discussing the advisability of having the local water supply treated electrically with a view to killing any disease germs.

Installation work is being pushed in the Palace of Electricity at St. Louis. The largest single shipment that has been placed consists of four carloads of exhibits from Germany. They are being installed in the northeast corner of the building and will include a very comprehensive electro-chemical display, as well as electrical apparatus by the best German makers. Nearly all of Germany's exhibit material for Chief Goldsborough's department is now in the building and the installation work is progressing rapidly.

The value of special franchises held by public service corporations in New York City is fixed by the State Board of Tax Commissioners at $251,521,450. This is $16,163,728 more than the total valuation for 1903.

The Signal Corps of the Army is now communicating daily by wireless telegraphy between Forts Schuyler and Wright, New York, a distance of 97 miles. The speed transmission varies from 10 to 30 words a minute, according to varying conditions. Similar apparatus will be installed at Nome and St. Michael, Alaska, as soon as weather conditions permit. The distance between these two places is 107 miles.

PECULIAR EXPLOSION OF WATER TUBE BOILERS.

BY JOHN C. HIGDON, M.E.

There occurred in St. Louis, on December 21st last, a most singular and destructive explosion of water-tube boilers.

That a genuine explosion took place, is evidenced by the photographs taken by the writer on the morning after the explosion, which occurred at about 5 o'clock P.M.

The views, Figs. 1, 2, 3, 4 and 5, show the enormous force exerted by the explosion, the same having spread apart the water-legs and pulled out the ends of nearly all the tubes, and the latter were thrown like toothpicks all over the place.

Fig. 1 shows the location of the boiler-room swept completely clean.

Fig. 4 shows several shells leaning against cars, where they were thrown and lodged fully 100 feet from their places, the water-legs being torn off at one or both ends of the shells. In one instance (Fig. 5), a water-leg weighing over a ton was thrown and lodged on top of a car standing in the car-sheds over 400 feet away.

FIG. 1.

Fig. 2 shows the rear end of one shell with its water-leg attached. The small pipe is the blow-off pipe, not the feed-water pipe, the latter having been attached to the front end of the shell.

Fig. 3 exhibits the back ends of a pair of the shells, the force having been so enormous as to have sheared and torn out the rivets.

The exploded boilers were quite old and had been subjected to over 12 years' continuous hard usage in the plant of the St. Louis Transit Company, having been erected in 1891 by the Heine Safety Boiler Company.

Seven boilers exploded, the same having been located at one end of a battery, of 23, all connected to a single steam header.

Seven men were killed, most of whom were colored firemen. Property to the amount of $50,000 was also destroyed.

There were fortunately very few persons employed at the plant, or the loss of life would have been much greater, and especially if the boilers had been located in the basement of one of our city's sky-scrapers.

FIG. 2.

The coroner's jury held as follows:

"Either the boilers and apparatus connected therewith were not in good condition, or there was incompetency or negligence in running the plant."

No inspection had been made by the St. Louis boiler inspector since February, 1903, almost a year ago, and so no blame could be laid at his door, as the law requires inspection but once a year.

But it seems there had been a recent inspection by one of the Casualty Companies, and the Transit Company's chief engineer, who was on duty at the time the explosion occurred, testified, when asked what kind of an inspection had been made a short time before, that he and the inspector "walked up and down the boiler-room and he looked at the water column which shows the level of water in the boilers."

FIG. 3.

Needless to say that if such action constituted an "inspection;" there might as well not be any made in the future, because all real, live engineers know that the water column connections frequently become stopped with mud and scale and render the glass-gauge and try-cocks unreliable, even though plenty of water be shown there.

Undoubtedly there is much room for reform in boiler inspections, and as the feed-water pipes were found to be plugged with scale on the exploded boilers, we suggest that inspections hereafter, particularly on water-tube boilers, include taking down the feed-pipes.

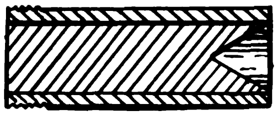
A sketch of the two feed-water nipples of one of the boilers is shown. One was found entirely plugged up with hard scale, so that not a drop of water could enter, and the other had but a $\frac{1}{8}$ inch passage, utterly inadequate to supply so large a boiler, the same being rated at 250 hp.

FIG. 4.

There were no fusible plugs in the boilers.

This would seem to have been a clear case of low water, in at least one of the boilers, as the feed pipes were badly plugged with scale, and the engineer testified, that he depended entirely upon the glass-water gauge to indicate the amount of water in the boiler. He also testified that just before the explosion one of the boilers had been cleaned and supposedly filled with water, and fired up; and the probability is that the tubes weie only partially filled with water owing to the plugged feed-pipes, and when fire was applied the steam accumulated to an enormous pressure, as the header-valve was also perhaps closed; and there is good evidence that a number of the safety-valves were so badly "stuck" with scale and corrosion that they could not possi-

bly have opened at anything under 500 pounds to the square inch. There was also evidence that a new header had just



Left Nipple Fully Stopped.

been finished and connected to the boilers, so that it is very likely that the main steam valve was closed, cutting off the seven exploded boilers from the balance of the battery.

It is well known that the superheated water contained in a boiler under pressure will, when suddenly relieved of pressure, exert an energy per cubic foot equal to that exerted by one pound of black gun powder.. A reasonable explanation of such action lies in the fact that the water in a boiler has an enormous amount of heat stored within it; or, in other words, the reservoir or store-house for the latent heat, for the word "latent" means "stored."

Even supposing that boiler to have contained only a barrel of water, the same

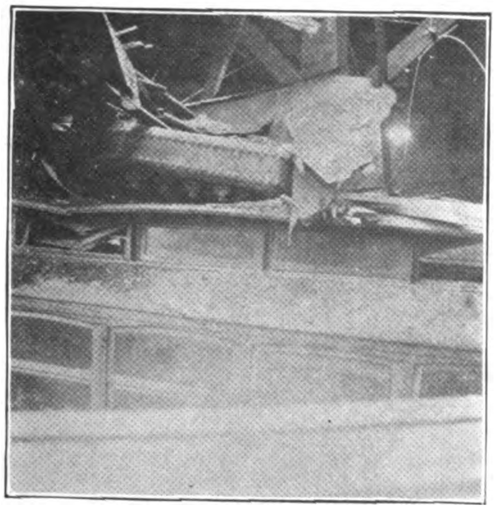
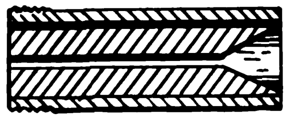


FIG. 5.

would generate a sufficient energy to tear any boiler to pieces when subjected to over-pressure and low water.

Many have wondered why the tubes alone did not burst, as usually occurs in explosions in water-tube boilers. In the present case, the tubes did not burst, but the water-legs were stripped off of the ends of the tubes, leaving the latter free.

The evidence points to the probability that but a single boiler caused the explosion, it having been suddenly relieved of pressure by a broken steam-header, or perhaps by the giving away of a number of overheated tubes during low water, with the safety-valve out of order and the header-valve closed; and this would be sufficient to break the header, and thereby release the steam contained in the remaining six boilers, which would have the effect of causing the superheated water contained in them to at once flash into a



Right Nipple Almost Stopped.

great volume of steam, which no boiler could possibly withstand.

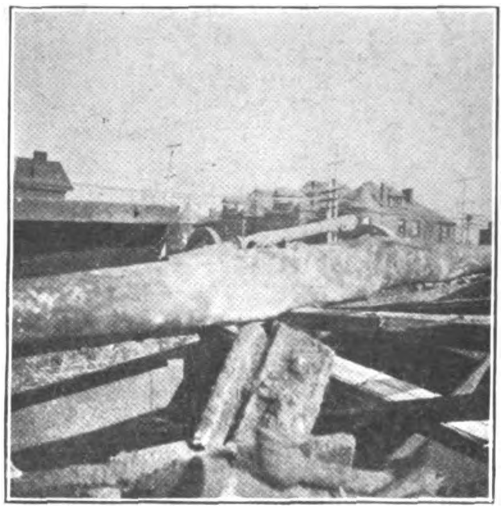


FIG. 6.

It was stated by some of the witnesses that the boilers exploded one at a time, and that seven consecutive explosions were heard.

Fig. 6 shows one of the tubes which had evidently been badly overheated and could only have been caused by low water.

Figs. 7 and 8 show the same tube at the top of a large pile of tubes. The ends of

FIG. 7.

these tubes bear clear evidence that they were stripped from the holes in the water legs.

The occurrence of the above described explosion should not at all detract from the popularity of water-tube boilers, as it has been clearly shown that the explosion occurred through no defect in construction. It would have required something like 1,000 pounds per square inch to have torn the shells of these boilers in the manner indicated in Fig. 2, and at other points observed by the writer while taking the photographs.

The writer therefore has no hesitancy in stating that, in his opinion, the Babcock & Wilcox, the Sterling, or any other water-tube boiler would have gone to pieces under like circumstances.

Since the foregoing was written the St. Louis Board of Engineers have made their report, as required by law, and they substantially affirm every statement, and even go farther in their condemnation of the street railway company's superintendent of motive power, Mr. Cook, who is not a licensed engineer, and yet is allowed under the present law to give orders to many licensed men under him. The board has revoked the license of the engineer who was on duty at the time of the explosion, on the ground of negligence or incompetency.

Right here is seen a fatal defect in the present law, and no time should be lost

FIG. 8.

in remedying it. No unlicensed man should be permitted to give orders to licensed engineers, even if the former be the employer.

The board report in part as follows:

"A test of the safety valves showed they required from 142 to 170 pounds to the square inch to force them open, when the law allowed them but 125 pounds.

"There has never been a boiler devised which cannot be exploded by an incompetent or careless engineer.

"A water-tube boiler in the hands of such an engineer is no safer than a fire-tube boiler."

Stone & Webster, Boston, have completed the consolidation of the railway and lighting properties in Ponce, Porto Rico, and all are now being operated under their management.

DASH POTS FOR CORLISS ENGINES.

ARTICLE V.

BY W. H. WAKEMAN.

Fig. 10 illustrates another dash pot in which air circulates from one part to another, instead of being drawn in and discharged in the usual way. It is much more complicated than any of the others

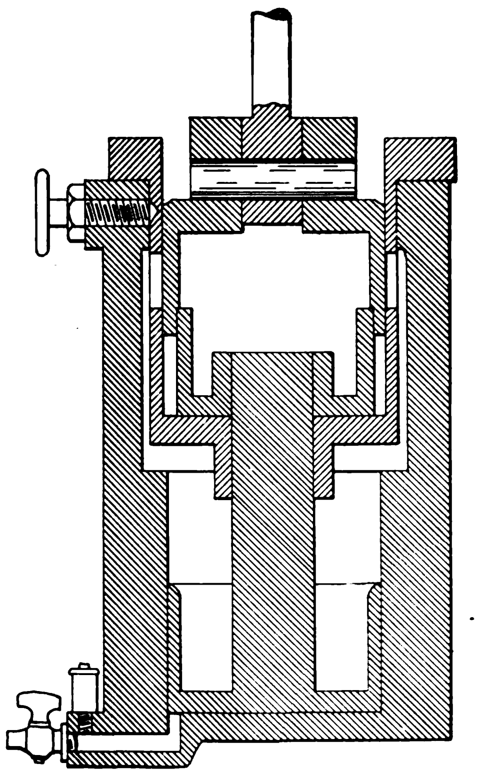


FIG. 10.

shown, yet it works smoothly and well. The passages are partly shown in the cut, and these are sufficient to give a general

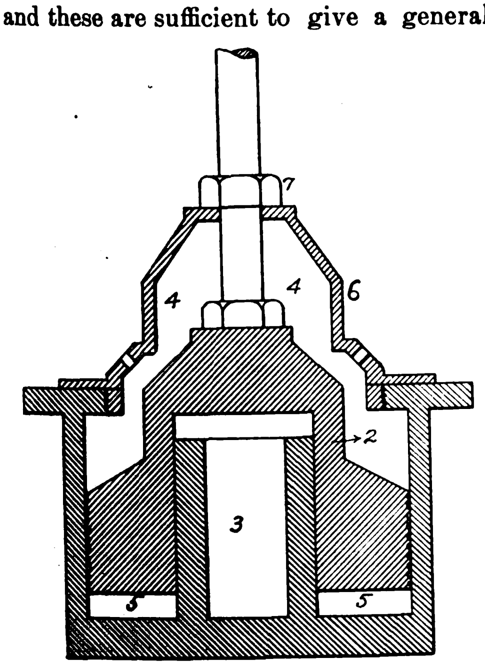


FIG. 11.

idea of the plan of operation, although not explained in detail as in former cases

The pet cock at the bottom is not for general use, but for the purpose of draining out oil when necessary. Dash pots require but little lubrication as they work vertically, therefore the friction is small.

Fig. 11 is another type that discharges no air. The piston, 2, is in about the middle of its stroke, therefore a partial vacuum exists in the chamber, 3 Air is now passing from 4 and 4 to 5 and 5 by means of the passages between the outer edge of piston at its greater diameter, and the cylinder walls. When the plunger reaches its limit of travel there will be a greater degree of vacuum in 3, or in other words, the air pressure in 3 will be reduced still lower.

When the plunger descends it cushions on air in 5 which is compressed and driven upward into 4. The operation is continued indefinitely.

The whole cap 6 may be unscrewed by applying a wrench to the nut, 7, as it is not connected to the dash pot rod. This rod is fastened rigidly to the plunger.

The first Corliss engine that I was placed in charge of was fitted with dash pots located beneath the engine room floor, in a little dark and dirty place where a man could not stand erect. The light of day never penetrated to it, and the plungers were so placed that it was both difficult and dangerous to oil them thoroughly while in motion.

My second Corliss engine resembled the first in this respect, and was unsatisfactory accordingly, as it was necessary to go down a short ladder and get into these disagreeable quarters every time that the devices required attention.

One day while examining one of these dash pots by the light of a candle it was brought too near some small pieces of waste, or something of that kind saturated with oil, and in an instant a lively blaze was started. As the engine room floor was only about one foot above this spot, and oil was actually dripping down from it, the prospect for a destructive fire seemed good, but some vigorous work in

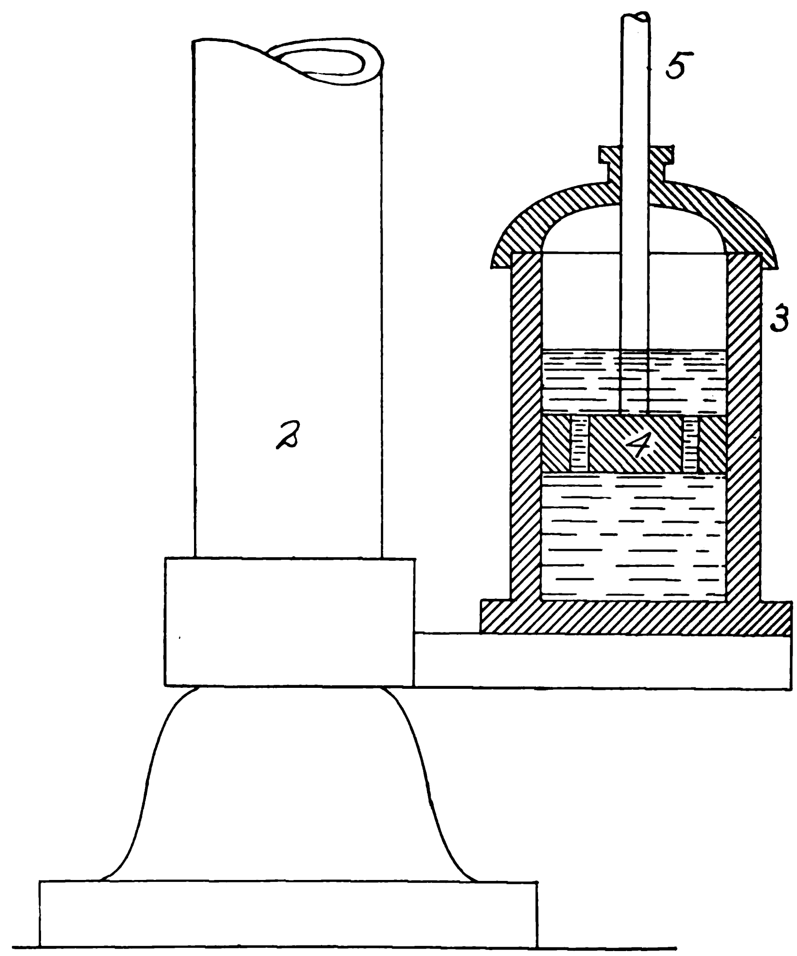


FIG. 12.

self defense, disposed of the fire, and the danger was past. This is the reason for my strong objections to dash pots placed under the floor.

Another objection is based on the fact that unless the rod of a dash pot so located is unusually heavy, it will constantly vibrate or tremble, and this does not appear right, as everything should be solid about an engine.

The improvement which ranks next along this line, is the plan of placing dash pots on a level with the floor. While this is a move in the right direction, it still calls for a long rod, especially where the cylinder is large.

The next change noted is placing them on the cylinder feet, which brings them

about 1 foot above the floor. This makes them accessible for oiling and adjusting, and allows the use of a comparatively short rod.

As a rule we go to extremes in all things if given time enough, and this matter is no exception to the general rule, for the next move was to place them just below the steam valve stems, but above the exhaust valve connections.

No special point is gained by this change, and when oiling the valve gear of such an engine in motion there seems to be enough machinery about the wrist plate, without bringing dash pots into the collection.

While a rod that is too long vibrates and is not satisfactory, one that is too short does not operate at right angles to the bore of the cylinder, hence it tends to draw the plunger away from its proper course. Placing the dash pot on a cylinder foot seems to be a satisfactory medium between the two extremes that gives the best results.

The principle objection to the Corliss engine is due to the fact that the wrist plate with its connections seems complicated to the casual observer, and the dash pots working quietly and easily, or noisily and hard, as the case may be, add much to this objection, especially with a compound or triple expansion engine, as more than one cylinder is in use. The fact in the case is that the Corliss engine is one of the most simple and easily understood in use at the present day, when we consider the results secured by it, and the dash pots are not so objectionable as they appear, for when once properly adjusted they need no further attention for many weeks, except to oil them once a day.

Dash pots are not used on Corliss engines exclusively, as the title of these articles might imply. The idea was to consider those that are so used, consequently the title is appropriate.

Wherever a disengaging cut-off valve gear is used a dash pot of some kind becomes necessary, to gradually arrest the motion of the moving parts, preventing unnecessary wear and noise.

Sometimes a dash pot is attached to the governor of a Corliss engine to prevent the balls from suddenly changing their position, and other engines are also fitted with the same device. It is sometimes called a "gag pot," but it is one form of dash pot nevertheless. The operation of it will be understood by an examination of Fig. 12.

The body of the governor is shown at 2 to which is secured a bracket on which the dash pot, 3, stands; 4 is a loose fitting plunger with several holes bored through it, and 5 is the dash pot rod. The pot is about two-thirds full of oil which circulates through the plunger as the governor balls cause it to rise and fall by means of the rod, 5.

If the balls tend to fluctuate in their path, the dash pot plunger counteracts this tendency, as it cannot travel faster than the oil allows it to, as it changes from one side to the other. There are two ways of regulating this rate of travel, one of which is to vary the capacity of the holes, and the other is to use a thick or a thin oil, according to conditions.

Suppose that six holes ¼ inch in diameter are bored in the plunger, each of which is tapped and a screw fitted into it. If all of the screws are left in place the plunger will move very slowly, even if filled with kerosene oil. Removing one of the screws may make it right, or more may have to come out, but the capacity of the holes is great enough to allow a rapid movement.

If it moves too easily with kerosene, substitute engine oil, and if this is too thin use cylinder oil.

A certain engineer in charge of a large Corliss engine, found that after running it several months, it suddenly failed to maintain a steady speed, as the governor balls traveled from their highest to their lowest limit rapidly, and it took him several days to discover the cause.

In the meantime the mill employes were all disgusted on account of the varying speed, which made it impossible to do good work. After much worry and annoyance the engineer discovered that there was a dash pot on his governor, and that there was no oil in it. A quart of engine oil was a remedy easily applied. If he had read a description of this appliance as here given, it would have saved him much trouble.

THE ELECTRO MECHANICAL COMPOUNDING OF GENERATORS.*

An ideal regulator should come into operation at the same instant as the changes of load for which it is to compensate, so that the necessary additional driving power may be supplied as required. If the steam engine or turbine-driven dynamo is a compound wound one, the voltage will be constant at all loads, but if shunt wound, the excitation must be altered to suit each load change, and if this alteration is accomplished at the same time as the change in driving power, no voltage variation will occur. The governors employed up to the present on prime movers driving dynamos have the essential drawback that a change of speed must actually occur before they can come into action. It is obvious that in such a case a variation in dynamo voltage must occur, due partly to this change in speed and partly to the strictly electrical change. The regulation, in fact, is carried out at present by letting the governor do its share and then adjusting the excitation by means of a variable resistance.

Recently Mr. Routin, of Lyon, has succeeded in producing regulators which comply with the ideal conditions stated above. It is clear that for every load on the dynamo a particular value of the excitation, as well as a particular amount of steam admission, are necessary, and this naturally suggests that both excitation and admission should be controlled by the same piece of apparatus. Every change of load is followed by a voltage change, partly due to ohmic drop and armature reaction—i. e., electrical causes—and

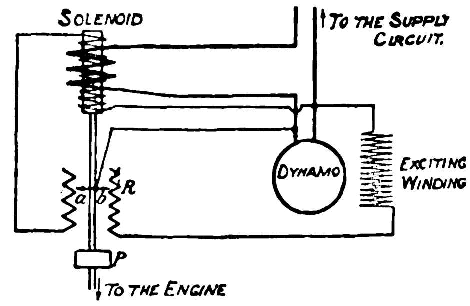


FIG. 1.

partly due to speed changes—i. e., mechanical causes. The changes due to electrical causes can be counteracted instantly, but those due to mechanical causes are not so quickly dealt with, as they are subject to the law of inertia. Good regulation requires that the steam admission should be increased and the excitation be strengthened at the same time, whenever either the current increases, the voltage drops, or the speed drops, and vice versa. An apparatus in which the differential action of the current and the voltage is employed may, therefore, be expected to give good results. With Routin's regulator the action may be compared to what would occur if, each time a lamp were switched on, the engineer in charge took the trouble to alter both the steam admission and the excitation of the machines.

The apparatus consists, in principle, of an iron core acted upon by the difference in ampere-turns of a main circuit coil and a shunt coil connected to the terminals (see Fig. 1). The main coil carries the current generated by the machine at each instant. The shunt coil, which is con-

*Translation in abstract of an article by F. Broek in "Elektrotechnische Zeitschrift, Jan. 14, 1904. From the "Electrical Engineer," London.

nected in opposition to the main coil, is fed from the generator terminals in series with a regulating resistance, the amount of which is determined by the position of the sliding contact, *a*. At the same time a second sliding contact, *b*, moves over the resistance, R, and alters the excitation of the machine. The dimensions of the two coils are chosen so that the shunt coil normally overpowers the main coil. The iron core of the solenoid is directly connected to the admission gear of the engine and carries a weight, P, producing a permanent downward pull. When the iron core moves downwards the admission is increased, and when it moves upwards increased. Suppose that the speed, voltage, and steam admission are normal, and that the weight, P, is held in a certain definite position by the differential action of the windings. Suppose also that the voltage of the dynamo keeps constant at all loads—i. e., the machine is compound wound. Then any increase in load will correspond to an exactly proportional increase in the current delivered by the machine, and the ampere-turns of the main coil will increase, so that the overpowering action of the shunt coil will be correspondingly diminished. This will lead to a fall in the iron core, and this produces an increase in steam admission. At the same time, contact *a* will have moved down and reduced the resistance in the shunt coil. As soon as the shunt coil increase becomes equal to the main increase in the opposite direction, the iron core will come to rest.

If the dynamo is a shunt-wound one, it is only necessary to make the change of position of contact *b* alter the dynamo exciting current sufficiently to maintain the normal voltage. In the case of a short circuit occurring, the main coil ampere-turns will reach an excessively high value, and will then overpower the shunt coil, reverse the polarity of the iron core, and cause it to rise, thus closing the admission valve. Should a main fuse blow, only the shunt coil on the solenoid will remain in action, and this again will effect the closing of the valve. Should the speed of the machine be altered, due to any external cause, such as a change of head (in the case of turbine-driven sets), etc., the currents in both windings of the solenoid alter proportionately, and their difference becomes greater or smaller according as to whether the speed had increased or diminished. In the former case, the iron core is drawn further up, and so closes the admission valve, whilst in the latter case the reverse occurs. The contact on the excitation resistance can be adjusted by hand whilst running, and the degree of compounding can, therefore, be adjusted at will. If both contacts are altered together by hand, the loading of the machine can be adjusted as required, so that when several machines are running in parallel the load on any one of them can be varied in any way desired.

ELECTRICAL STATION PRACTICE.

ARTICLE XXX.

BY W. H. RADCLIFFE.

In an electrical station where accumulators are used for helping out the generators during periods of heavy load they are usually connected so that they will be automatically charged by these same generators when the load is light.

The general connections between the accumulators, generators and distributing circuit is given in Fig. 29. The number of accumulators at *a* should be such that the total normal voltage developed by them will be practically the same as the rated voltage of the generator or genertors at *b*. The connections in Fig. 29 show the accumulators to be in multiple with the generator across the distributing circuit. When the load on the distributing circuit is such that the generator *b* is developing its normal current, the accumulators will neither deliver current to the line nor take current from the generator. If the load increases above this amount the voltage of the generator will drop, unless the machine be compound wound, in which case the voltage will increase slightly, but all the current in excess of the capacity of the generator will be supplied by the accumulators which will then be discharging into the distributing circuit. On the other hand when the load on the distributing circuit is light, the excessive voltage of the generator over that of the accumulators will act in charging the latter.

During the discharge of the accumulators the specific gravity of the electrolyte and the voltage of the battery will fall. If the value of the specific gravity becomes less than 1.20 a portion of the electrolyte should be siphoned off and a fresh quantity of solution having a higher specific gravity added. Owing to injury to the plates concentrated acid must never be added to the electrolyte in a battery without first being diluted. As to the drop in voltage, this will usually be gradual, but should never be allowed to fall below 1.7 volts per accumulator, since after this point is reached the pressure will drop more rapidly and the plates are then liable to sustain injury. Voltmeter readings of the individual accumulators and also of the voltage across all of them must therefore be made from time to time, the former readings to determine whether each accumulator is properly performing its duty and the latter readings to show how much further the discharging process may yet be continued. Of these measurements, the individual readings will be low and a direct current voltmeter having a capacity of 5 volts will be plenty large enough. For the total voltage, however, a direct current voltmeter having a capacity of 150 or 750 volts may be necessary, so that it is obvious two instruments or an instrument having a high-pressure and a low-pressure scale will be required for the purpose.

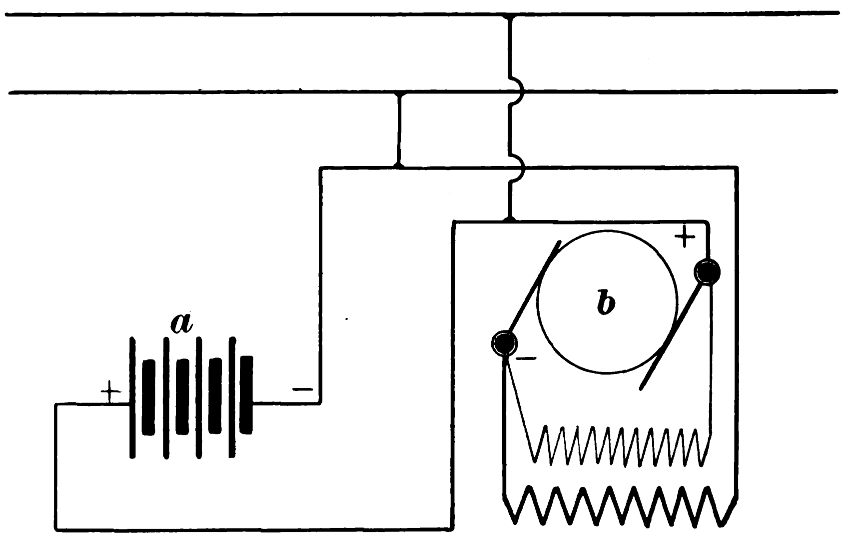


FIG 29.

In modern types of accumulators the normal rate of discharge should not ordinarily exceed 8 amperes per square foot of positive plate surface, although the advice of the manufacturers should be obtained and followed in any given case when possible. It is not advisable to discharge a storage battery beyond the point where 25 per cent. of the original charge remains. This matter, however, will properly adjust itself if the voltage limitation previously mentioned be not exceeded.

In the management of a storage battery plant may be found a practical verification of the quotation "Eternal vigilance is the price of safety." The defects that usually occur in the battery may, if discovered in time, be generally remedied by properly treating the affected parts. The most common of the troubles that may be anticipated is the sulphating of the plates. By this is meant the formation of a deposit of white sulphate upon the plates, caused usually by a too rapid rate or a too slow rate of discharge, or by the electrolyte being too weak or too strong. Sulphating, if allowed to continue, will cause the active material of the plates to become loosened and fall out; it may also cause internal short-circuits between the plates, and if not remedied will eventually decay the lead plates or grids. The remedy for accumulators in this condition is to charge and discharge them at a slow rate, although if the sulphating is very far advanced it may be necessary to scrape the deposits off the plates by means of a stick and then give them a thorough washing in the battery solution. Under no circumstances should metal be used for the scraping process, nor should water be used in washing the plates after being scraped. As soon as the plates are washed they must immediately be returned to the jars or tanks containing the electrolyte, which latter should perfectly be renewed at this time.

In some accumulators separators are not employed between the plates, and whenever such a battery is overcharged there is always liable to be more or less trouble caused by the twisting or buckling of the plates. This defect may be prevented by employing wood, rubber or glass separators between the plates, or by a slow rate of charging and discharging as recommended for sulphated plates.

The life of a storage battery may be taken as that of the positive plates, and under average conditions in electrical station practice this is approximately three or four years. The life of the negative plates is always longer than that of the positive plates, but both positive and negative plates suffer deterioration and in wearing leave a deposit in the bottom of the jars or tanks. In order that this deposit may not readily come in contact with the lower parts of the plates and thus short-circuit them, they are supported by lugs or ribs so as to leave a space in which this deposit may collect between the plates and the bottom of the containing vessel. It is necessary, however, to clean out this deposit from time to time in order to avoid internal short-circuits as previously mentioned. Such foreign substances as dirt, nails, bolts, etc., must be kept away from the tops of the accumulators, else they fall in unnoticed and ruin the battery before the trouble has been located. Broken separators may also lead to internal short-circuits, although this defect is not of very common occurrence. A good plan to follow and one which will often aid in the prevention of trouble consists in numbering the accumulators and keeping a record of each one; then, when the battery as a whole is not giving satisfactory results, the fault may usually be located at once by examining those accumulators whose records are below the average.

Passing the charging current through the battery in the wrong direction will seriously injure the plates, and may possibly destroy them entirely; it is therefore necessary to make certain that the like poles of the charging circuit and of the battery are connected together. Various forms of pole testers are on the market for accomplishing this purpose, but after the first test, which can be made with a voltmeter, the wiring may be so arranged that there need be no confusion. In making this test with the voltmeter it should first be connected across the charging circuit, and when the pointer of the voltmeter is deflected in the proper direction over the scale the wire connected to the left-hand binding post should be marked. A similar test with the voltmeter is then made across the two terminals of the entire battery installation, and when the wires are so connected to the meter that a deflection in the same direction as before is obtained, the wire joined to the left-hand binding post of the voltmeter is of the same polarity as that of the wire of the charging circuit previously marked. These two wires must therefore be connected together in charging, and as the remaining wires must necessarily be of the same polarity they also may be connected together.

In describing the chemical reactions taking place during the charging process it will be remembered that considerable hydrogen gas was generated. This gas is explosive, and care must be taken, particularly when the battery is inclosed within a poorly ventilated space, not to bring a lighted match or other exposed flame near the cells or accumulators. For inspecting the working parts of a battery, a special form of incandescent lamp on the market, which is provided with a flat bulb and wired to a lighting circuit with a flexible wire conductor, will be found very convenient and effective, when inserted in the cells, to light up the dark passages between the plates.

When a storage battery is used only occasionally, or when it is to be out of service for several months or longer, special rules must be followed or the battery will become worthless in the meanwhile. During the time the accumulators are inactive they will gradually become discharged on account of certain local losses constantly going on within them. The normal capacity of the latter, under such conditions, cannot be obtained by simply recharging, it being necessary to first entirely discharge the accumulators and then give them a fresh charge. This should be done weekly even though the accumulators are used several times during each week, and if a single charge can be given them this often, no serious results will ensue even though the battery be left unused for a much longer period. If, however, it be desired to leave them without any attention whatsoever, this may be done by first giving them a full charge and then siphoning off the solution. The siphoning can be best done with a three-eighths of an inch red india-rubber tube; this should be filled with the electrolyte by dipping it into a vessel containing the solution and then pinching the ends of the tube so that the electrolyte will not run out until one end of the tube is inserted in the battery jar or tank, and the other end is placed in an empty vessel at a lower level. The ends may then be allowed to open, whereupon the solution will run out of its own accord. The tube should never be sucked to start the process, for the solution is both poisonous and corrosive, and if by accident any of it be drawn into the mouth the results would be serious.

After the solution has been siphoned from the accumulators, the plates may be taken out and placed in water so that all of the acid will be removed from them, after which they should be withdrawn and allowed to dry. The positive plates should then be separated from the negative plates, the former packed away, and the latter again placed in electrolyte having a density from 1.275 to 1.300 and soaked for three or four hours. After being once more rinsed and dried, they two are ready to be packed away. The wooden separators are generally useless after being in service and may as well be thrown away, but the rubber separators should be washed in water and preserved.

The arrangement of the accumulators within the station forms an important factor in their operation and should therefore merit considerable attention. If they are placed too closely together, or if they stand directly upon the floor, the electrolyte which naturally creeps more

or less will form a conducting film between the jars or tanks resulting in a leakage of the current. Such leakage may discharge the battery without the knowledge of the attendant. Moisture of any kind outside of the accumulators must consequently be eliminated as far as possible by providing the battery room with sufficient ventilation, and also by allowing some space between each of the cells and between the cells and the floor. Glass or porcelain insulators may advantageously be used for supports, but upon these boards should be placed, so that the weight of the battery is more evenly distributed upon the insulators and they are therefore less liable to break than would be the case were each accumulator placed upon its respective insulators. In all cases the boards should be varnished to maintain a high insulation resistance. The creeping of the electrolyte may be avoided by applying to the rim of each of the jars or tanks a coating of paraffin about an inch wide on their inner sides; in some cases insulators are used in which oil may be placed, the oil offering an obstruction to the creeping of the electrolyte and thus prevents leakage.

In placing the accumulators in position it must also be remembered that each of them must be located so as to afford accessibility in case of examination or repairs. If the necessary amount of floor space is available they should all be mounted upon supports resting upon the floor; if, however, the floor space is limited they may be arranged in tiers one above the other. When the accumulators are small and can readily be placed in position by hand there is not much objection to this method if ample space be allowed between them, but when the accumulators are large, requiring a tackle or a traveling crane to place them in position, it is evident there is much to be said against it. In order that the examination and repairs previously referred to may be easily accomplished, it is necessary that the storage battery room be well lighted through windows by day and by means of incandescent lamps by night. Care must be taken, however, to prevent the rays of the sun shining directly upon any part of the accumulators. It may be mentioned in this connection that when the batteries are provided with glass jars, inspections can more quickly be made than when metal, rubber or wooden tanks are employed.

The floor of the battery room should be constructed of some material unaffected by sulphuric acid; concrete or brick may therefore be used, but wood should not be employed. In order that the floor may easily be cleaned with water from time to time, it should incline slightly toward a drain. If at all possible, the battery room should be separated by a partition, or otherwise, from other parts of the station containing machinery; this is necessary on account of the corrosive effect which sulphuric acid fumes have upon unprotected iron.

Storage battery attendants are subjected to certain inconveniences, and in fact dangers, if certain rules are not carefully observed. The more important of these rules will conclude the discussion of this subject. Smoking must not be indulged in by those engaged in the battery room; in fact, any exposed flame or spark will as previously stated ignite the hydrogen gas and cause an explosion of more or less violence. Sore hands frequently result from contact with the electrolyte, but if they be dipped from time to time in a supersaturated solution of washing soda and water, the injurious effect will be counteracted. Particularly destructive is the battery solution on clothing, but a small application of ammonia fortis to the affected parts will usually remedy the matter by neutralizing the acid.

STANDARD PRACTICE IN THE USE OF ALTERNATING CURRENT ELECTRICAL APPARATUS.*

BY J. J. GIBSON.

In the whole range of the arts the growth of none has been so rapid as that of the electrical. In a space of time so short as to seem miraculous, within a period almost as short as 15 years, there has been a complete growth from "infancy" to maturity, from the experimental to the practical.

The characteristics of electrical appliances in the commercial arts can be said to-day to have settled into fixed lines of practice. Advance there will be, but it will proceed along lines already clearly defined. Inventions and discoveries of far-reaching value are to be expected as time goes on, but none is conceivable of a nature so revolutionary in character as to make any essential change in practice which is at present considered standard.

During the 15 years just passed every electrical device and system has passed through the fiery furnace of actual trial, and this process of refinement has thrown out the dross. We have left, therefore, only those things which are fittest; first and foremost those things which are simple, for in simplicity lies every advantage and economy.

Alternating current apparatus was first put on the market in this country at a time which marked the beginning of a period or great electrical development. Its introduction and exploitation may be said to be responsible for that great development. The direct current systems in vogue at that time had reached the limit of their development, and the time was ripe for another system of distribution of power which would permit of a wider scope of action. In extending the old direct current systems it was found that the cost of copper put into feeder circuits was growing to a point which was almost prohibitive.

As the amount of copper for the transmission of a given amount of power with a given loss is inversely proportional to the voltage used, alternating current generators were put forward because a higher voltage could be generated without commutating the current. They were not used prior to that time, perhaps because the pioneers in the art knew how to use nothing but direct current, since previous to machines they had drawn all of their current from batteries or thermopiles. When they found their machines generated alternating current they devised the commutator in order to turn it into direct current. Excepting direct current, constant current arc machines, whose current capacity is limited to about 10 amperes, the highest voltage at which current of any volume can be successfully commutated is, perhaps, about 600 to 700 volts; not high enough to effect very much saving in copper for transmission in constant potential distribution, and too high for safety.

The first alternators brought out, however, were arranged to give approximately 1,000 or 2,000 volts, and with them was offered the lowering transformer to secure a safe working voltage for entering buildings. The transformer was found to work both ways, that is it could be used to raise as well as lower electrical pressure, and long transmission lines became feasible.

The induction motor was developed and water powers began to be utilized. Rotary converters, turning alternating into direct current, enable traction companies to widen their systems. The resulting development in all lines has been phenomenal and it is likely to be greater still.

While all these things were being worked out, the very apparatus which made them possible was itself in process

*Paper read at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

of development. The old direct current school of electricians objected to alternating current apparatus first, because it appeared to be very complicated. The equation, $C = E \div R$, no longer solved every problem. To-day, while perhaps the theory of alternating currents is still a mystery to the uninitiated, nevertheless, alternating current apparatus is simplicity materialized. While in the state of development, each new device which was brought out used a new frequency, a new voltage, a new combination of phases, a new wrinkle of some kind, only of value to create a possible monopoly if the device were successful, and the result has been a heterogenous mass of apparatus, most of which can now be found in the scrap heap. The process of refinement of actual trial, however, has resulted in the survival of the fittest, just as might have been expected, and the fittest is the simplest.

One tendency clearly discernible in this evolution has been directed toward the elimination of moving contacts in circuits, or the reduction of the number of such contacts to a minimum. The principle carried to the extreme in generators led to the inductor generator with no moving wires of any nature. This type of machine, however, was found to be lacking in other qualities. It has very poor regulation and very much reduced output on power factor load. The result has been the development of the revolving field generator. In this type of machine the moving contacts are reduced to two in number, through which the exciting current is carried to the field coils, which are on the revolving element of the machine. This was not a step backward, for in the main power circuit of such a generator, there are no moving contacts, and what could be more simple than a generator of this character carrying a load of induction motors of the short-circuited secondary type?

We may say that the revolving field generator has become a fixture. In comparatively small machines the revolving armature generator is just as good for both belted and direct connection and it has some advantages. It can be built lighter for the same output. The stationary part of the revolving field machine must be built heavier to prevent collapse of the frame than is required for magnetic conductivity. For machines of equal output the revolving field generator requires larger exciting current than the revolving armature machine. Other things being considered also, the revolving armature machine is more efficient. We may say, therefore, that up to a certain size the revolving armature alternator is also a fixture, provided the voltage and amperes are within certain limits. One thousand amperes can be taken from a collector ring with successful operation, and without excessively expensive collector ring construction. If the current per terminal in any machine is greater than 1,000 amperes, the machine should be of the revolving field type; however, rotary converters are of necessity revolving armature machines and currents as high as 2,000 amperes per collector ring are taken from them. If the voltage desired from the machine is greater than 2,600 to 3,000 volts, the machine should be of the revolving field type.

We may expect to find the revolving armature machine always in use and on the market because the lines of the various manufacturers have been fully and carefully developed, and in sizes up to approximately 200 kw., and for ordinary distributing voltages not exceeding 1,100 to 2,200 volts, the revolving armature machine may be considered the more desirable. It has a higher efficiency than the revolving field machine and takes a smaller exciter. A revolving field machine has the advantage of it only by reason of the fact that there are no moving contacts in the main circuit. As we go to larger sizes and higher voltages the revolving field machine shows more advantages. Voltages such as 6,600 or 11,000 are possible from stationary armature windings, which can be more perfectly insulated than windings which are in the revolving element of the machine.

Alternators are built both separately excited only and compound wound or composite wound. The latter type have series coils on the field poles through which a current is sent after being rectified by a commutator on the shaft of the machine. This rectified current is taken from the secondary of a series transformer, the primary of which is in the main circuit from the armature of the alternator. Large alternators are now built separately excited only with no compounding. Eight per cent. inherent regulation, full load to no load, is standard, and if better regulation than that is desired in operation, varying the field current by changing the field rheostat by hand is resorted to. If composite winding is necessary in a generator, the indirect method of compounding is desirable, in which the compounding current is sent through series field coils on the exciter and not through any field coils in the generator itself. Automatic compounding of alternators gives satisfaction only on non-inductive loads. Automatic compounding devices have been put forward designed to secure proper voltage regulation irrespective of the power factor of the load, but none such has been a success so unqualified as to make its adoption in any way general. Such devices can not, therefore, be called standard practice.

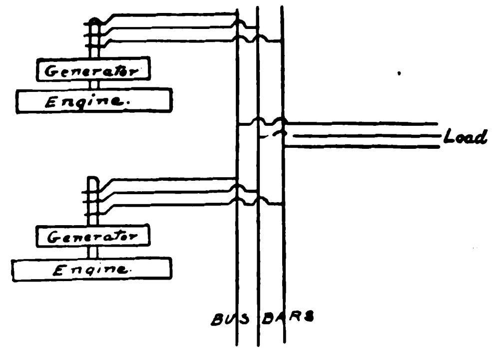


FIG. 1.

Direct connection versus belted connection is not an electrical problem so far as choice of method goes. This is naturally a matter of expense to be justified by the conditions surrounding any given installation. The engine requirements, however, for successful parallel operation of alternating current generators are more severe for direct connected units than for belted. The same considerations apply to the parallel operation of belted units, but belt slip lessens the evil effects of improper engine performance. If we consider, therefore, the case of engine type or direct-coupled alternators in parallel we will be investigating the more important one.

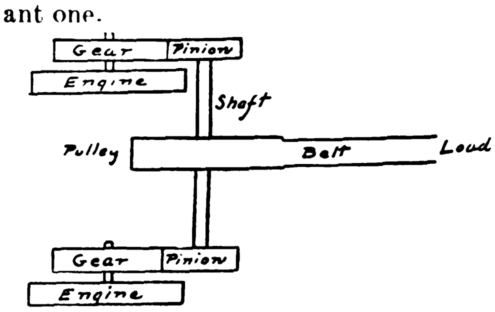


FIG. 2.

There is one way of considering this problem, and that is by means of a mechanical analogy. Let us take two units, each consisting of an engine driving an alternator, and let each alternator be connected to a set of bus-bars to which the load is connected, as shown in Fig. 1. Let us take, on the other hand, two units each consisting of an engine on the shaft of which is a gear. Each gear has its teeth intermeshed with those of a pinion on another shaft common to both pinions. On this shaft there is a pulley belted to the load. Let us imagine that the shaft is somewhat flexible. This arrangement is shown in Fig. 2.

Let us now suppose that the apparatus

in Fig. 2 is in operation. On account of the flexibility of the shaft a slight variation in angular position of the gears at each end is possible, but when such variation exists the elasticity of the shaft tends to draw back to a position where there is no such variation. Suppose one of the engines advanced for some reason. It takes more than its share of the load and a very few degrees of displacement would remove the entire load from the second engine. The governor of the first engine acts to admit more steam, because the engine is being called upon for more power. The governor of engine, Fig 2, immediately acts to cut off steam, because that engine is not being called upon for as much power as it had been delivering, but at the same time the elasticity of the shaft has been acting to pull the engine, Fig. 2, up to speed, and does pull it beyond that point, so it becomes the engine running in advance and all of the conditions are reverses.

You can see how an oscillating action is here set up, like the swinging of a pendulum. If the engine governors happen to have a period of swing, you can see how they would set up an oscillating action between themselves, shifting the load from one engine to the other, on the same principle that a child might "work up" a swing, that is, by first starting the pendulum action and then applying the power at that point of the travel of the swing which would increase its amplitude. If, furthermore, the natural period of swing of the governors corresponds to that of the elastic shaft, everything will combine to assist in swinging the load from one engine to the other.

(*To be continued.*)

Proposals Invited.

The Navy Department, through the Bureau of Yards and Docks, is inviting sealed proposals until April 23 for furnishing the New York Navy Yard with one turbo-generator with exciter set, five induction motors, one motor generator, two switchboards and accessories, together with installation of the same. The appropriation for the work is $44,000. Specifications will be furnished by the Bureau or by the commandant of the New York Navy Yard.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until April 12 for furnishing the navy yards at Norfolk, Va., and Pensacola, Fla., with a quantity of arc lamps, electrical supplies, conduit and fittings, rubber-covered wire and weatherproof cable. Blank proposals will be furnished upon application to the Bureau at Washington or to the Navy pay offices in the above-mentioned cities.

The Bureau is also inviting sealed proposals until April 26 for furnishing the navy yards at Portsmouth, N. H., Boston, Mass., and New York with one 24-inch electrically-driven engine lathe, one electrically-driven deck winch, and seven 20-hp. electric motors. Blank proposals will be furnished upon application to the Navy pay offices in the above-mentioned cities or to the Bureau at Washington.

Sealed proposals are being invited until April 9 for electrical work at Fort D. A. Russell, Wyo., as follows: For wiring buildings, furnishing and installing fixtures, wattmeters, etc., for constructing primary, secondary and arc light lines, furnishing and installing transformers, cut-outs, street light hangers, street lights, etc. All proposals previously received for the above work have been rejected. Full information, plans, specifications, etc., will be furnished upon application to Capt. W. S. Scott, Quartermaster U.S.A., Cheyenne, Wyo.

Hyatt Roller Bearings.

Ground has been broken and contracts let for a 75-foot addition to the new machine shop of the Hyatt Roller Bearing Company of Harrison, N. J. Although it is only six months since its large shops were completed the constant increased demand for Hyatt Bearings has made it necessary to again increase the plant. The new addition will be of brick construction, two stories high. The ground floor will be fitted with modern heavy machine tools, while the second floor will be used exclusively for assembling automobile bearings. The building will be completed by May 15.

PERSONAL MENTION.

Mr. Giuseppe Marconi, the father of the inventor, died at Bologna, Italy, Saturday, aged 83 years. William and another son were present at their father's deathbed.

Mr. Winthrop Murray Crane, ex-Governor of Massachusetts, has been elected to the directorate of the Western Telephone & Telegraph Company.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 22, 1904.

Electric Railways and Appliances.

755,140. Electric Railway-Signal. Bertram M. Kershner, Pittsburg, Pa. Filed June 21, 1902.

755,391. Electric-Railway Shoe. Henry Rosenfeld, New York City. Filed Aug. 19, 1903.

755,460. Electric Locomotive. William Dalton and Francis J. Cole, Schenectady, N.Y., assignors to the American Locomotive Company, New York City. Filed Nov. 17, 1903.

755,509. Car-Fender. George Linhard and Philip Linhard, Sublett, Mo. Filed March 9, 1903.

Electric Lights and Appliances.

755,306. Electric Tube-Lighting. Daniel M. Moore, Newark, N. J. Filed Jan. 19, 1903.

755,307. Electric Tube-Lamp. Daniel M. Moore, Newark, N. J. Filed Feb. 6, 1903.

Electrical Machinery and Apparatus.

754,980. System of Speed Regulation for Motor-Driven Machinery. Gano S. Dunn, East Orange, N. J., assignor to the Crocker-Wheeler Company, Ampere, N. J. Filed Aug. 20, 1903.

755,029. Armature Winding or Coil. Frank A. Merrick, Johnstown, Pa., assignor, by mesne assignments, to the Westinghouse Electric & Manufacturing Company. Filed Nov. 9, 1899. Renewed Dec. 16, 1901.

755,048. Automatic Circuit-Closer. James L. Russell, Boston, Mass. Filed Nov. 2, 1903.

755,066-755,067. Power-Transmitting Device. William R. Smith, Buffalo, N. Y. Filed July 18, 1903, and Aug. 10, 1903

755,141. Electrical Switch Mechanism. Hubert Krantz, Brooklyn, N. Y. Filed June 29, 1903,

755,165. Electric Switch. Ashley P. Peck, Milwaukee, Wis., assignor to the Hart & Hegeman Manufacturing Company, Hartford, Conn. Filed Sept. 21, 1903.

755,203. Electromagnetic Rail-Brake. Karl A. Wilde, Hamburg, Germany. Filed Dec. 1, 1903.

755,281. Electric Time-Switch. Joseph Dilhan and Ernest de Mersanne, San Francisco, Cal. Filed Aug. 27, 1903.

755,297 Automatic Circuit-Breaker for Electric Time or Other Switches. Arthur W. Hutchins, Providence, R. I. Filed May 15, 1903.

755,358. Retarding Device for Electric-Circuit Breakers. Algernon R. Cheyney, Philadelphia, Pa. Filed Dec. 2, 1903.

755,367. Static Electric Machine. Ernest E. Fewkes, Newton, Mass., assignor of one-half to Frederick W. Cole, same place. Filed June 1, 1903.

755,393. Electric Connection. Frank J Russell, New York City. Filed Nov. 6, 1903.

755,468. Rheostat. Arthur C. Eastwood, Cleveland, O. Filed Dec. 21, 1903.

755,537. Coil for Dynamo-Electric Machines. Ferdinand Porsche and Ludwig Lohner, Vienna, Austria-Hungary. Filed July 11, 1902.

755,590. Power-Transmitting Machinery. Edwin Winans, New York City. Filed Jan. 8, 1904.

Telephones and Telephone Apparatus.

754,968. Telephone. Martin C. Burt, Chicago, Ill. Filed March 17, 1903.

754,054. Service-Meter for Telephone-Lines. Charles E. Scribner, Chicago, and Frank R. McBerty, Evanston, Ill., assignors to the Western Electric Company, Chicago, Ill. Filed April 2, 1900.

755,091. Telephone-Transmitter. Joseph A. Williams, Cleveland, O., assignor to the Williams Telephone & Supply Company, same place. Filed April 10, 1903.

755,127. Electric Selective System. Julien A. Gehruing, St. Louis, Mo. Filed Feb. 8, 1902.

755,308. Service-Meter for Telephone Lines. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Filed July 16, 1900.

755,515. Counting System for Telephones. Johann H. Meyer, Madgeburg, Germany. Filed May 26, 1902.

Miscellaneous.

754,969. Storage Battery. Martin C. Burt, Chicago, Ill. Filed Aug. 13, 1903.

755,032. Apparatus for Wireless Transmission of Energy. Daniel M. Moore, Newark, N. J. Filed April 18, 1903.

755,121. Electrical Apparatus for Therapeutic Purposes. Frederick C. Fisher, Bristol, Eng. Filed Sept. 21, 1903.

755,142. Storage-Battery Construction. Simon Lake, Bridgeport, Conn. Filed Dec. 17, 1903.

755,173. Electropneumatic System of Driving, Johann Sahulka, Vienna, Austria-Hungary. Filed April 18, 1903.

755,229. Coil for Electromagnets or Other Purposes. Friedrich Klingelfuss, Basle, Switzerland. Filed Sept. 28, 1900.

755,282. Electromagnetic Separator. Myron Dings, Milwaukee, Wis. Filed May 23, 1903.

755,305. Peaked-Wave Wireless Transmission. Daniel M. Moore, Newark, N. J. Filed June 14, 1902.

755,382. Device for Testing Electric Currents. Charles Oliver, Woolwich, Eng. Filed Nov. 29, 1902.

755,487. Thermostat. Daniel H. Haywood, New York City, assignor to the Davis & Roesch Temperature Controlling Company, same place. Filed Dec. 23, 1902.

755,525. Stamp-Battery Guide. William S. McDonough, Ouray, Col., assignor of one-half to Thomas H. Woods, Ouray County, Col. Filed March 24, 1903.

755,546. Diffusion-Battery. Alois Rak, Cesky Brod, Austria-Hungary. Filed Aug. 1, 1903.

755,577. Electric Vibrator. William MacMillan, New York City, assignor of one-half to Egbert Winkler, same place. Filed July 29, 1902.

755,586. Method of Selecting Electrical Impulses. Daniel W. Troy, New York City. Filed July 11, 1903.

THE TELEPHONE WORLD.

Independent Companies Will Combine in Eastern New York.

With a view to making long-distance connection with Syracuse, Utica, Rochester, Binghamton, Buffalo and other towns of this State, Pennsylvania and Ohio, action has been taken at Troy for the consolidation of the Rensselaer Telephone Company of Troy, the Saratoga Telephone & Telegraph Company of Saratoga Springs, and the New Union Telephone Company of Glens Falls. The new company is to be known as the Commercial Union Telephone Company. The officers are: President, John T. Christie, of Troy; secretary, W. N. Burk, of Glens Falls; treasurer, Peter McCarthy, of Troy. The necessary action on the part of the old companies, it was announced, will be taken immediately.

It was said that before the end of the coming summer the long-distance connection would be made with Syracuse. The companies now have about 3,500 telephones in use.

It is the intention at once to extend the lines north to Plattsburg, east to North Adams and other Massachusetts cities, and west at an early date and form alliances so that in a few months direct connections can be made as far west as St. Louis.

For some time there has been talk of a local telephone exchange in Red Wing, Minn., in which D. M. Neill and associates purpose to interest themselves. The intent is to make it a distinctly Red Wing concern, in which all who desire may have an opportunity to to take stock. The company would connect with Independent lines throughout this and adjoining States, and particularly with the long-distance lines of the Tri-State Telephone Company, and also the Twin City Telephone Company. President E. H. Moulton, of these companies, has been in Red Wing for a conference on the subject.

The Farmers' Telephone Company, composed of agriculturists of Burlington and Camden Counties, N. J., are constructing a rural telephone service between Merchantville, Ellisburg, Maple Shade and Moorestown. The new line when completed will connect with the Delaware & Atlantic Telephone Company at Moorestown.

The Black River Telephone Company has completed the rebuilding of its long-distance system, and now gives excellent service to all points between Utica and Watertown, N. Y. Its system has been connected with the Utica Home Telephone Company system ever since the concern began business, but its service has been greatly improved lately.

The Saltfork Telephone Company has been organized for the purpose of constructing and operating a line from Quaker City, O., out into the country for several miles. W. N. Cowden is president, and H. H. Floyd secretary and treasurer.

The Belgian Government has completed a telephone line through a thick jungle, 750 miles wide, in the heart of Africa, which enables the various Belgian colonies to communicate with one another.

The Montpelier, O., Telephone Company has increased its capital stock from $15,000 to $50,000.

Stromberg-Carlson Company's Plant to be Enlarged.

It is announced that the Stromberg-Carlson Telephone Manufacturing Company, which has extensive buildings in Rochester, N. Y., is at once to make a considerable addition to its plant at that point.

Thomas W. Finucane said that the company will at once construct an addition to its cable department building. The addition will be 60 by 200 feet in size. This, said Mr. Finucane, would double the capacity of the cable manufacturing department.

The company owns ten acres of land on Culver road, adjoining the New York Central Railway. At the present rate of building, the entire tract will soon be utilized for buildings for manufacturing purposes.

Telephone Company's Expansion.

The Newark, N. Y., Telephone Exchange, which was established by William H. Kelley, in 1899, has now 230 'phones. Its capital is $25,000, which consists of $5,000 worth of 6 per cent. preferred stock, which has been subscribed by local business men, while Mr. Kelley will retain $15,000 worth of common stock, it not being expected that the balance will be issued. The exchange will be improved during the summer with a modern switchboard, and three miles of aerial, lead-covered cable will be installed. The Home 'phones in Wayne County now connect with Lyons, Clyde, Savannah, Butler, Wolcott, Rose, Sodus, Williamson, Ontario, Walworth, Macedon, Palmyra and Newark. Exchanges will be installed at Palmyra and Marion during the coming summer.

These exchanges are connected with Phelps, Clifton Springs, and over the Interocean line with Geneva, Canandaigua, Rochester and Buffalo and many other towns throughout the State reached by the Independents.

At the annual meeting of the Gage County Independent Telephone Company, held at Blue Springs, Neb., the following officers were elected: A. R. Morris, president: A. S. Reiff, vice-president; J. B. Graham, secretary; Dr. W. L. Albin, treasurer.

The Armstrong Telephone Exchange Company of Truman, Minn., has filed an amendment to its articles increasing its capital stock from $25,000 to $100,000, and its limit of indebtedness from $5,000 to $25,000.

The Cumberland Telephone Company has opened an exchange for business in Rayne, La., with about 100 subscribers. This same company is to establish an exchange at Belzona, Miss.

The municipal boards of Meridian, Miss., have granted a franchise to a new telephone company which promises good competitive service.

The Hay Springs-Alcove, Neb., Telephone Company, with a capital stock of $25,000, has filed articles of incorporation with the Secretary of State.

The Dutchess County Telephone Company of Poughkeepsie, N. Y., reports a constantly increasing demand for its service.

Independent Lines to Co-operate in Service.

The Association of Long-Distance Telephone Companies, the object of which is to provide for telephonic communication over Independent lines between Philadelphia and Kansas City, was formed at a meeting of telephone magnates, including several Louisville, Ky., men, which was recently concluded at Indianapolis, Ind. The range north and south will be from Michigan to Kentucky, inclusive.

J. D. Powers, of the United States Trust Company, one of the Louisville delegation, said of the plans:

"There were 40,000 miles of Independent long-distance lines represented at the meeting. All arrangements were made to fill in the gaps between Philadelphia and Kansas City at an early date, and before many months have passed we will be in the field for long-distance telephone business on a better basis than was ever before offered the public.

"The organization of this new association should in no sense be taken to mean that there was an amalgamation of the interests involved. It only means that the Independent long distance telephone lines will co-operate in giving long-distance service."

The system will be put into use as soon as practicable. Before a thorough system is possible, however, it will be necessary to make connections between several small gaps in the proposed territory.

The stockholders of the Adamsville, O., Telephone Company held a meeting and elected the following officers: President, J. B. Rhodes; vice-president, C. H. Hanks; secretary, F. P. Winn; treasurer, M. F. Tomlinson; manager, F. P. Winn; counsel, S. M. Winn. The stockholders made plans for the construction of an up-to-date exchange. The farmer lines will also be extended into the rural districts adjacent.

The report of the American Telephone & Telegraph Company for 1903, issued last week, showed gross revenue of $16,545,632, an increase of $3,268,175; net revenues, $10,564,665, an increase of $2,729,393; dividends, $8,619,150, an increase of $2,035,000, and balance, $1,945,514, an increase of $694,000. In the course of the year $35,368,700 was spent for exchanges, toll lines and land and buildings, and 677,228 miles of wire were added to the plant.

The cables of the new Prospect telephone exchange at Clinton and Atlantic avenues, Brooklyn, N. Y., were recently cut in. The building is seven storied, fireproof and cost $350,000. The switchboard is unusually large, and can accommodate 12,000 subscribers.

Telephone Incorporations.

The Farmers' New Era Telephone Company, Hebron, Ill. Capital stock, $5,000. Incorporators: George Hunt, L. A. Nichols and J. H. Turner.

The Sangamon Telephone Company, Williamsville, Ill. Capital stock, $2,500. Incorporators: J. M. Cooper, P. J. Telfer and R. U. Richardson.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Ashland, O.—C. W. Garver, clerk of the board of trustees, wants specifications at once for an electric light plant.

Bridgeport, Ala.—B. C. Jones, city clerk, states that a franchise has been given to A. Grant Davis, of Parkersburg, W. Va., for the erection of an electric light and power plant.

Cadiz, Ky.—From present indications it looks as though this city is to soon have an electric light plant. E. E. Wash, of this place, and Joe. L. Parsley, of Princeton, have been figuring on putting in a plant of this kind, and are greatly encouraged by the city council.

Coalville, Utah.—A petition has been presented to the city council signed by C. A. Callis, T. L. Beech and others, asking for a 50-year franchise to install in the city an electric light plant. The matter was referred to the committee on city property.

Cody, Wyo.—Hon. George T. Beck, has been granted an exclusive franchise to supply electric light to this place. Col. Cody is associated with Mr. Beck in the enterprise, and a plant will be installed within the next two months.

Excelsior, Minn.—This city is to have a new electric lighting system soon.

Flora, Ind.—This town is considering the advisability of having an electric lighting plant.

Fulton, Ky.—Lewis Graham and his assistants have purchased a controlling interest in the electric light and power plant.

Gurdon, Ark.—The city council has granted to S. S. Harris and Dr. T. L. Hodges a franchise for an electric light and power plant. Work will begin at once to secure estimates on the plant.

Hackensack, Minn.—There is considerable talk of putting in an electric light plant here.

Jackson, Mich.—Frank Cornwell, of Ann Arbor, president of the Ypsilanti Paper Company and the old Jackson Pulp Company of this city, is seeking a franchise to build an electric light plant on the Huron River at Foster's Corners.

Jacksonville, Fla.—The proposition to bond the city for waterworks and to enlarge the electric light plant is said to be favorably considered by many citizens.

Knox, Ia.—The Knox electric light plant has been sold to Thomas A. Grist, who will improve same and add new machinery.

Lodi, O.—This village has entered into a contract with Clement Williams, of Akron, to light the town with electric lights.

Newport, Ky.—The amount of $10,000 has been set aside for the municipal electric light plant, and $50,000 will be added yearly until the required sum is obtained. J. B. Morlidge, city engineer.

Ottawa, Ont.—It has been determined not only to light the whole stretch of the Welland Canal by electricity instead of gas, but by the same motive power to operate the gates, valves, bridges, and sluceways of the canal. The electricity will be furnished by the Cataract Power Company.

Perryville, Mo.—L. M. Moore, formerly of this city, is trying to interest local capitalists in the establishing of an electric light plant here.

Rockville, Md.—A bill is before the Legislature to authorize the expenditure of $50,000 for water, sewer and an electric light system. Eugene Jones, Cornelius W. Clum, Theodore J. King, William L. Lewis and J. B. Stubbs are on the committee to consider the matter.

Rusk, Tex.—An electric light plant will be erected by W. W. Welsch, Dr. Wiggins and others.

San Antonio, Tex.—Bids are asked until April 6 for lighting the streets with gas or electric lights for two years, with the privilege of five years. John P. Campbell, mayor.

San Bernardino, Cal.—The San Bernardino Gas & Electric Company will install new machinery in the proposed sub-station.

San Diego, Cal.—The council has granted Charles E. Sumner, of Cleveland, O., an electric light and gas franchise here.

San Jose, Ill.—The matter of erecting an electric light plant is now being agitated. T. O'Neil is interested.

Springfield, O.—It is reported that the electric lighting company will install a new system for the streets.

South Stillwater, Minn.—The village council has decided to advertise for bids for $15,000 in bonds to be used in erecting an electric light plant. Bids will be opened April 2.

Statesboro, Ga.—Sealed proposals will be received until April 12 by the mayor for the erection of an electric light and waterworks plant. The electric light plant will consist of one 90 kw. alternator, one 135 hp. automatic engine, 20 arc lamps, wire transformers, pole lines, etc.

Table Grove, Ill.—This village is figuring on purchasing an electric light plant.

Taunton, Mass.—The Legislature approves of the appropriation of $2,343 to install an electric light plant for lighting and heating the Taunton Insane Hospital.

Tipton, Ind.—Dynamos with a capacity of 10,000 incandescent lights will be installed by the city electric light plant.

Uniontown, Ky.—The electric light plant has been sold to C. F. Cecil, of Springfield, Ky. Improvements will be made.

Weeping Water, Neb.—John Cook, of Julian, is applying to the council of this city for a franchise to put in an electric light plant.

Williamsburg, O.—Appropriation has been made, but bonds for erecting the electric light plant have not been sold. One contract will be awarded to cover all work. Plans and specifications have been prepared. C. H. Lockard, mayor.

Wise, Va.—A company has been organized by Gen. R. G. Ayers, of Big Stone Gap, Judge Fulton and others, to supply electric lighting and water here.

Youngstown, O.—A co-operative electric lighting and power plant is one of the possibilities in the near future for this city. B. M. Moss, manager of the Scotch Woolen Mills Company, is at the head of the project.

STREET RAILWAYS.

Albany, N. Y.—A four track electrically equipped railroad, for 35 miles between New York City and Croton—two tracks for fast trains and two for trains running practically without schedule, after the manner of long-distance trolley lines—is the plan behind a bill introduced last week by Assemblyman Apgar at the behest of the New York Central Railroad Company.

Atlanta, Ga.—The Piedmont Electric Railway Company has been incorporated by E. C. Atkins, T. J. Hightower and others, to build a line from this city to Roswell, Alpharetta and Cumming, Ga., a distance of 23 miles.

Bessemer, Ala.—At a late meeting of the city council, franchises were granted to the Bessemer Blue Creek and Blocton Electric Light & Power Company, which proposes to build a line of steam or electric railway, connecting Bessemer with 60,000 people who inhabit the mining regions contiguous to this city.

Elmira, N. Y.—The Elmira & Corning Short Line was lately incorporated with a capital of $500,000, to operate an electric railroad line from here to Corning, a distance of 13 miles.

Ithaca, N. Y.—If the plans of the promoters go through, and there is now every indication that they will, Binghamton and this city will be connected by an electric line.

Newark, Ark.—The Syracuse & Eastern Electric Railway Company has been granted a franchise here.

Rockford, Wash.—There is some talk about an electric railroad through this place to connect with the beet sugar factory at Waverly. Farmers have expressed a willingness to donate a right of way through their farms for the enterprise.

Scranton, Pa.—The Delaware, Lackawanna & Western Railroad in installing an electric traction system in anthracite coal mines near here, to take the place of mules, expended $129,000 last year.

Sioux City, Ia.—The Sioux City Traction Company will make improvements this season costing $50,000.

Whitestone, N. Y.—The Belmont Syndicate is asking for a franchise to build a trolley line here.

POWER PLANTS.

Asheville, N. C.—B. F. Burk and G. A. Shideler, of Marion, Ind., are contemplating establishing an electric power plant here during the coming summer.

Eureka, Cal.—The Eureka Lighting Company, of which T. D. Petch is superintendent, will develop water power on Trinity River for generating electricity for power and light. It is said that $500,000 will be expended upon the plant and general improvements.

Oneida, N. Y.—De Witt C. Hadcock, of this city, recently took C. C. Morgan, general manager of the Stanley Electric Manufacturing Company of Pittsfield, Mass.; H. H. Barnes, chief engineer of the same company, and W. H. Hand, a representative of Cramps' shipyards of Philadelphia, to inspect the Limekiln Falls on the Oneida Creek. It is proposed to harness the falls and generate electricity for motive power. It is expected that enough can be generated to furnish power for Oneida and all of Madison County.

Sundance, Wyo.—The Economic Power Company, organized by Henry K. Mayham, of Denver, will build a $900,000 power plant west of this place, and supply power and electric light to many towns and mines in the Black Hills.

NCTES FOR INVESTCRS.

Latest quotations for copper are: Electrolytic, 12⅝@13c.; Lake 12⅞@13c.; casting, 12⅝@12¾c.

The stockholders of the Fresno Traction Company of California will vote May 18 on issuing $5,000,000 for extensions.

The annual stockholders' meeting of the Marconi Wireless Telegraph Company will be held April 18 at noon in Jersey City.

The governing committee of the New York Stock Exchange voted to close the exchange on Good Friday but not on the following Saturday.

The directors of the Electric Storage Battery Company have declared the regular quarterly dividends of 1¼ per cent. on both the common and preferred stocks.

The Bell Telephone Company of Missouri will vote on an increase of its capital from $4,000,000 to $10,000,000 at a special stockholders' meeting, to be held May 17.

As soon as market conditions will permit, the Keystone Telepone Company of Philadelphia will ask authorization to issue $5,000,000 bonds, of which $3,500,000 will be sold at once.

It is reported that the gross business of the National Carbon Company for the first quarter of the current year will show an increase of 10 per cent. as compared with the same period of 1903.

Electric lamp manufacturers of the United States have been in conference in Cleveland, O., for several days. It has been agreed that the several manufacturers maintain but one price for the same grade of goods.

The Boston Suburban Electric Company has declared a quarterly dividend of 50 cents per share, payable April 15 to stockholders of record March 30—a reduction of 50 cents from the previous dividend.

The tax valuation of the New York Edison Company has been raised from $9,650,000 in 1903 to $11,515,000 this year, and that of the New York Telephone Company from $2,831,000 to $4,592,000.

It is stated officially that the General Electric Company will show an increase in its earnings for February and March of nearly 10 per cent. each month as against the corresponding months of last year.

A deed conveying all of the property of the Michigan Telephone Company to the Michigan State Telephone Company, as the assignee of N. W. Harris, the purchaser under foreclosure, has been filed in Detroit.

The stockholders of the Birmingham (Ala.) Railway, Light & Power Company at a special meeting voted to authorize the directors of the company to issue $10,000,000 worth of refunding bonds, the same to bear interest at the rate of 4½ per cent.

The Brooklyn Rapid Transit Company has spent during the last year over $1,300,000 in purchasing minority stock of subsidiary companies. The money to make these purchases was obtained from the last sale of 4 per cent. bonds. The outstanding stock of the subsidiary companies now amounts to only $995,000.

Attorney-General Guion of Louisiana has brought suit against the New Orleans Railways Company, a New Jersey corporation, to have the company declared unconstitutionally incorporated and therefore unable to do business in Louisiana. The company has a capital of $80,000,000 and most of its bonds are held in New York. It controls all the street and suburban lines of New Orleans, besides owning the gas works and electric light plants of that city.

ELECTRIOAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Mar. 28
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	142¾
Metropolitan Street Railway	111¼
Metropolitan Securities	78½
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	43⅞
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	63
Philadelphia Traction	97¼
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	139½
West End Street, com	92½
do. do. do. pref	109½
Chicago.	
City Railway	161
North Chicago	87
Union Traction, com	5½
do. do. pref	32
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	22
do. do. pref	56
Electric Lead Reduction	⅞
Electric Vehicle, com	7
do. do. pref	11
Westinghouse, com	164½
do. pref	194
General Electric	166
Boston.	
Edison Electric Illuminating	234
General Electric	167
Massachusetts Electric Companies, com	19
do. do. do. pref	73
Westinghouse Electric & Mfg., com	78
do. do. do. pref	89
Chicago.	
Chicago Edison	152½
National Carbon, com	28½
do. do. pref	98
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	56¾
do. do. do. pref	56¾
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	124½
Western Telephone Company	8¾
New England Telephone Company	120½
New York.	
American Telegraph & Cable Company	84¾
Commercial Cable Company	191¾
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88½
Miscellaneous.	
Chicago Telephone Company	118
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	32
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

Electrical Pumps for Fire Protection.

A little over a month ago we referred in these columns to the talk that was going on by the mayor and some of the city fathers of utilizing salt water below 42d street in Manhattan Borough for fire purposes.

From present indications this was not *mere* talk, and it really looks as though the city will in the not very distant future have an independent system of salt water mains with the North and East Rivers as the storage reservoir.

This question of adequate water supply for fire purposes is being agitated through Fire Chief Croker, who complains of inadequate pressure in the existing system. In a recent interview he is reported as saying:

"The circulation pressure of water through the system of this city is so poor that the Fire Department has been handicapped at every large fire that it has been called on to fight during the last winter. Tests that have been made at the hydrants from time to time independent of the facts recorded at the fires show that the water pressure has been all winter and is now way below what it should be. I need only cite the facts recently acquired at big fires to prove this. Last Sunday (March 27) I had the water pressure taken at several hydrants on lower Broadway near the scene of Saturday's fire (March 26), and found that the pressure that day, when there was no drain on the water supply, as there is on a business day, was only ten pounds, when it should have been thirty pounds at the lowest."

The mayor has requested the borough engineers to prepare plans for a salt water system of supply. In designing the system it is sincerely to be hoped that the scheme suggested by ELECTRICITY on August 1, 1900, and again by the mayor recently, of having electrically operated pumping stations will be adopted. With a number of electrical pumps, operated by surplus current from the elevated and surface roads, there should be no complaint of lack of pressure. In the event of a fire the pumps could be started instantly by turning a switch and there would be no valuable time lost in shaking up or starting fires as would necessarily be the case with steam pumps. This feature of the proposed system should receive careful consideration by the designing engineers.

* * *

January Exports of Electrical Machinery.

A careful examination of the list of exports of electrical machinery from the United States to foreign countries for the month of January, which has just been made public, should prove interesting, especially to electrical manufacturers. All the machinery exported during that month reached a value of $445,099.

During January Great Britain was our best customer and purchased $93,686 worth of machinery. Strange as it may seem, of all the other civilized countries of the world Japan comes next with a total purchase of $71,518.

Spain either has no use for electrical apparatus or still harbors against us a feeling over the late war, for that whole country only spent during January $87 for American made machinery.

As Russia bought but $5,865 worth it is only fair to assume that Germany has a strong hold on its market for electrical machinery.

That this country is gaining a foothold in British South Africa may be inferred

by the item of $6,585 charged against that section.

To our own possessions, the Philippines, we sold $2,657 worth, the bulk of which probably was electric motors for trolley cars.

Numerous other countries purchased electrical goods from the United States during January in small amounts. A careful study of the statistics should prove interesting to manufacturers seeking to extend their export trade.

* * *

Report on the Paris Subway Disaster.

A report has just been prepared by a committee appointed by the Municipal Council of Paris, France, to inquire into the causes that led to the disaster in the underground tunnel of that city last August. According to the *Electrician*, London, the report is a very voluminous one. The principal recommendation, however, of the Technical Committee is that arrangements be made so that the trainmen may in case of necessity cut the current off the conductor rail at any point. It suggests that the rail be cut up into a number of separately fed sections, so that not more than five or six trains can be on any one section, and that every train shall carry a "short-circuiting bar" which can be dropped across the conductor and running rail in case of need and so actuate the circuit-breakers controlling the section. This is otherwise described as "a metallic arrangement with an insulated handle," and is apparently to be operated from the driver's cabin. The next most positive announcement is that the lighting of the stations and tunnels should be provided from a number of sources, some of them entirely independent, not only of the traction supply—as the lighting always has been—but even of the company's generating and sub-stations.

In view of the near completion of the New York rapid transit subway the findings and recommendations of the Paris committee should prove valuable, and the full report should be carefully read and studied by the Rapid Transit Commission.

* * *

Converting Steam Roads to Electricity.

The question of changing the motive power of steam railroads to electricity is receiving considerable attention in England at the present time. The subject was brought up before the London Institution of Electrical Engineers on March 10 in a paper by Mr. F. F. Bennett, who tried to demonstrate by means of detailed estimates, based on the total railway system of the United Kingdom, what railway companies stood to gain by proceeding "right off" with conversion to electric traction. He argued with the companies that they were quite wrong to proceed as at present by electrifying here a little and there a little. The paper came in for much criticism and it cannot be regarded as epoch-making in respect to electric railway literature, but it served as a text upon which to base a discussion. The majority of electrical engineers would rather see such sections as the Liverpool & Southport line (which is described elsewhere in this issue) opened than wait for amalgamation or uniformity of working to be brought about between railway companies. The Liverpool & Southport line is the most important piece of railway electrification that has yet been carried out in England, and the general belief is that it is *the* experiment (47 miles of track) which will lead to big things very soon. A few practical working results, such as we have referred to already in the case of the Mersey Railway and the benefits which are bound to accrue from the up-to-date equipment of the Liverpool & Southport section, will go a long way to convince—and move to action—the English railway manager and director. These are the men who are generally regarded as being obstacles in the way of electric traction.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The first section of the rapid transit subway in Manhattan, which was to have been opened to the public in June, will probably not be in operation until around October 1. This is partly due to delay in getting the dynamos and other electrical apparatus installed in the power house.

Representatives of the Japanese Government, including S. Tada, of the Japanese Navy, and Messrs. Timita and Nishikawa, electrical engineers, of Tokio, are in this country to purchase electrical machinery.

A British contemporary states that a railway to be operated by electricity will shortly be built between Rome and Naples in Italy. It will run from Rome across the Pontine Marshes to Terracina and thence to Formio, a small town which is practically a suburb of the important garrison town of Gaeta, and thence to Naples, following more or less the line of the coast. Energy will be derived entirely from water power, and mainly from the Tiber and the Volturno, the latter river almost bisecting the line and being capable of supplying the greater part.

Lead and zinc mining in the Galena-Joplin district of Missouri is to be revolutionized by using electricity instead of steam.

The Roentgen Rays Society will hold its convention in September in Cleveland, O.

The arrangements made by the Belgian Government for the sending of commercial messages by wireless telegraphy from Nieuport to the Dover-Ostend steamers have involved the establishment of a new Marconi station at Nieuport-Bains, says the London *Electrical Engineer*. The new station is equipped with the latest apparatus, and the staff of operators will maintain a continuous service.

An effort will be made before the Ohio Legislature adjourns to have that body pass a bill creating a Street Railway Commission, with powers to handle in some manner the question of traction franchises in the various cities of the State.

"Motorpathea cerebralis," the new disease to which chauffeurs are subject, is diagnosed by the London doctor who has discovered it as producing "temporary disorganization of the mental functions" and "derangement of the equilibrium of the nervous system."

A number of lightships and lighthouses along the east coast of England are to be fitted with wireless telegraphy apparatus with a view to the preservation of life at sea. If the experiment proves a success, according to an English contemporary, the balance will be similarly equipped.

The minerals collected during the work of excavation for the subway in this city are to be exhibited by the Rapid Transit Commission at the St. Louis Exposition.

German capitalists purpose to build 90 miles of electric railway from Cienfuegos, Cuba, with lighting plants for eight towns and a 10,000 hp. hydraulic plant. Contracts for construction will be let in about three months.

The Magnetic Club will hold its spring meeting at the Hotel Spalding, 127 West 43d street, this city, Thursday evening, April 21, at 6:30 o'clock. The officials of the telephone companies will be the guests of the evening.

THE LIVERPOOL-SOUTHPORT ELECTRIC RAILWAY.

(From our London Correspondent.)

The Lancashire & Yorkshire Railway has been converted so far as its Liverpool to Southport service is concerned from steam to electrical working, and while the main object in view is to regain the traffic which has been drawn away by the electric trolley competition, the general manager, Mr. J. A. F. Aspinall is one of the few English railway officials who has long realized that electricity permits of a greater development of traffic, even without any considerations respecting competition from tramways, than is possible under steam conditions.

The entire contract for the electrification of 47 miles of track, a power house with 12,000 hp. of plant and the complete train system, has been carried out in less than twelve months, and that without interfering with the running of the steam service. The contractors for everything save the rolling stock—which was built at the railway company's own shops—was carried out by the London firm Dick, Kerr & Co., Ltd.

Before proceeding to describe the system, I may mention that this is the first main line steam railway of any length in England to complete its electrification. The Mersey tunnel railways, to which reference has already been frequently made in these columns, is a short length of line of a special and exceptional character.

The distance between Liverpool and Southport is nearly 18½ miles, the total length of track equipped being equal to 47 miles of single line. There are few gradients and curves. There are fourteen intermediate stations, which lie at an average distance of about one mile apart on the southern most part of the route, but are more widely separated on the northern portion.

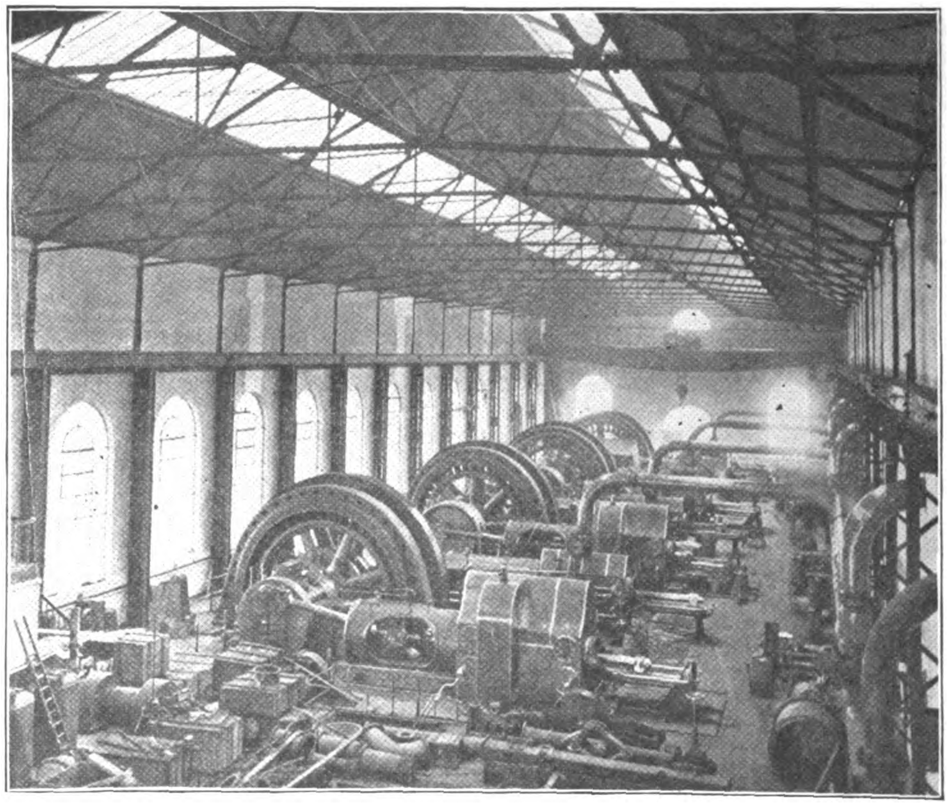
Under steam conditions there are about 36 trains per day in each direction between Liverpool and Southport; a similar number running in each direction between Liverpool and Hall Road, a station some seven miles from Liverpool. The majority of these trains stop at every station. A few express trains are run in between, these requiring 25 minutes, while the stopping trains take 54 minutes and the Hall Road stopping trains 25 minutes. The total train mileage per diem is about 1,900.

With electrified conditions the train mileage is being increased to 3,200. The number of trains between Liverpool and Southport, in each direction, will be increased from 36 to 65, and between Liverpool and Hall Road from 38 to 54. Furthermore, the running time from Liverpool to Southport will be decreased from 54 minutes to 37 minutes, and from Liverpool to Hall Road from 25 minutes to 17 minutes. Express trains will also be run.

Energy for working the line is generated as three-phase alternating current of 7,500 volts, this being transmitted direct to substations where the voltage is stepped down by static and transformed by rotary converters into direct current of 650 volts pressure, the maximum voltage at the train being 600.

The power house is situated at Formby, approximately the center of the line; it also serves as a substation for feeding to the adjacent track. In addition to the rotary converters at the main power house the scheme embraces three substations located respectively at Sand Hills, Seaforth and Birkdale. Near Liverpool it has been necessary to locate the substations closer together than on other parts of the line in order to cope with the considerably heavier traffic of some of the local trains. The extreme ends of the line—from Sand Hills substation towards Liverpool, and from Birkdale substation towards Southport and Crossens—are each fed by one substation, whilst for the intermediate sections of the line two substations participate in supplying energy to the trains, the demand of energy supplied from each substation depending on the position of the train between the substations. The substations are situated near the track, thus avoiding any low tension cabling, except a short connecting length. Any substation can be disconnected when required.

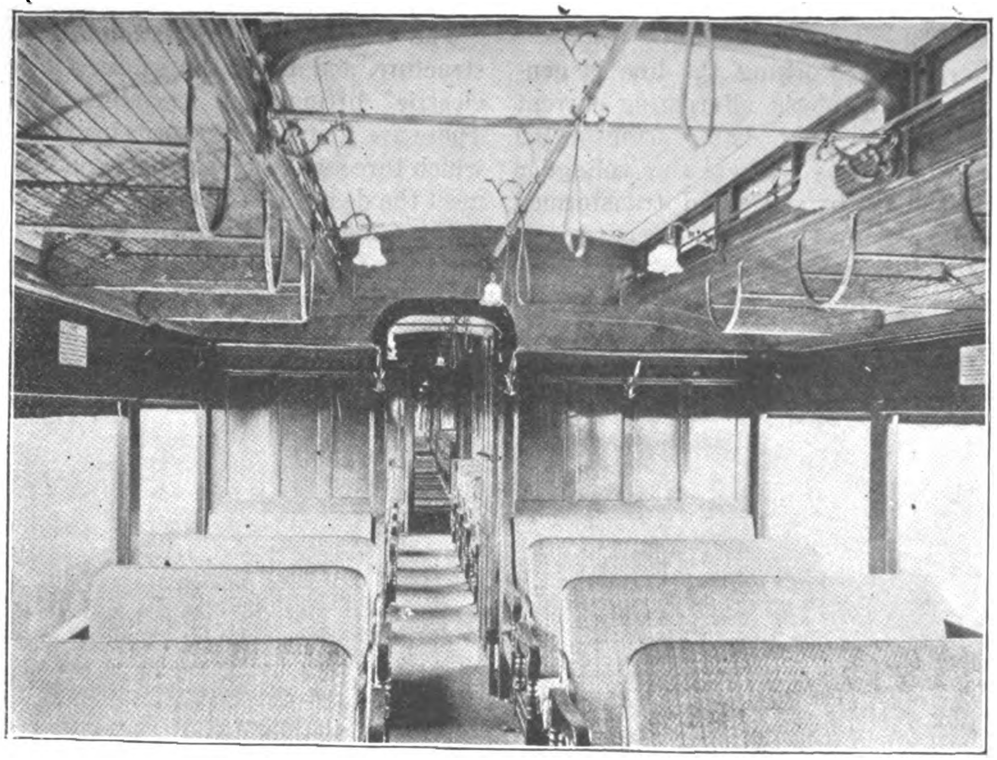
The Formby power station is a plain structure, and is of course served with electric lifting and traveling cranes. There are four 1,500 kw. sets installed, of which three will under normal conditions, meet the demands. There is also a fifth unit, of 750 kw., which will form a useful link between the larger units, and thus permit considerable flexibility in obtaining a good load factor with high efficiency.



View of Main Generating Station (Formby) on the Liverpool-Southport Electric Railway.

There are sixteen Lancashire boilers (Yates & Thom manufacture) each 32 feet x 8 feet 6 inches, constructed for 160 lbs. working pressure. A Galloway superheater is fitted in each of the downtake flues at the back end of the boilers. The boilers are arranged in two batteries of eight. Green's economizers, and induced draft apparatus (supplied by the Buffalo Forge Company) are employed. The steam feed ring (6 inches diameter) runs the whole length of the boilers, branches to each boiler being taken through check valves. The ring is supplied from the pumps in triplicate. The feed water can be passed either through the economizers or direct to the boilers by a duplicate system. The main steam piping is 12

inches in diameter and is a combination of the ring and by-pass systems. The steam pipes are in duplicate and are of steel. The exhaust pipes from the main engines are 24 inches in diameter and connected direct to jet condensers. The whole of the exhaust piping from exciter sets, fan engines, and boiler feed pumps is connected to an auxiliary surface condenser.

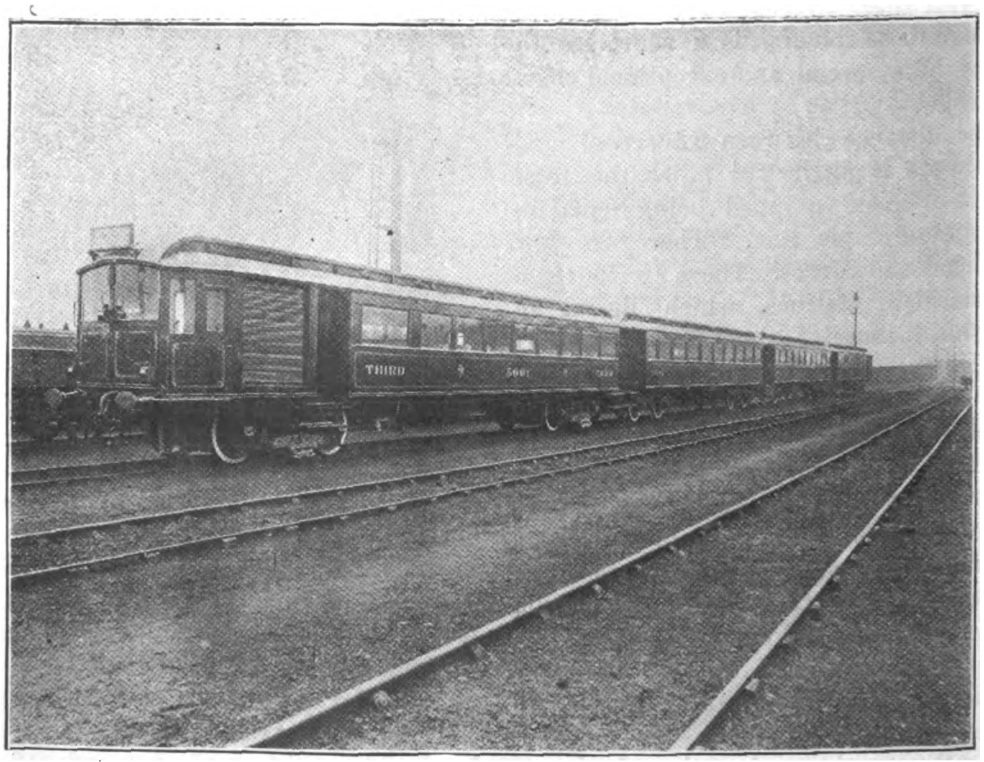


View of Interior of Car on the Liverpool-Southport Electric Railway.

The four main engines are also of Yates & Thom build, that firm having acted as sub-contractors to Dick, Kerr & Co. They are of the horizontal cross compound type (cylinders 32 inches x 64 inches diameter x 4 feet 6 inches stroke) and run at 75 revolutions per minute. The normal load of each engine is 2,310 hp. (160 lbs. pressure) but they are designed to give an overload of 20 per cent. Each flywheel is 22 feet in diameter, and is directly attached by strong bolts to the rotor, which is otherwise independent of the flywheel. Each engine has a motor-driven bearing gear.

The alternators are three-phase, 25 cycles, and they were built at the Preston factories of Dick, Kerr & Co., together with all the other electrical equipment. Each rotor or magnet wheel is carried between the cranks, the armature ring or stator being erected on its own slide beds, concreted in and bolted down on the engine foundations. The rotor carries 40 radial cast steel poles of oval section secured by tap bolts to the outside rim of two finished cast steel rings of massive T section carried and driven from a central cast iron spider by 16 axial bolts.

The pole tips are of laminated steel with a central air space—corresponding to grooves on the pole sides and the clearance between the rotor rings—dovetailed tight into the poles to keep the field coils in position. These are of bare copper strip wound edgewise. The outer surface of the coils is left bare to aid the dissipation of heat, while the central ducts on the poles give ample ventilation to the iron.



Four-Coach Train on the Liverpool-Southport Electric Railway.

The cast-iron spider is built in halves and clamped on the shaft by four heavy bolts. The magnet rings are also in halves but staggered relative to each other and the spider and shrunk together by double headed keys.

The cast-iron slip rings are of stiff section carried on either side of a cast-iron spider by axial bolts insulated with ebonite. On each slip ring bear three carbon brushes.

The weight of the magnet wheel complete is about 48,500 lbs., of which the poles account for 12,800 lbs. and the spools 6,350 lbs.

The stator consists of a cast-iron frame carrying the core disks on its inner periphery. The core segments are of annealed iron, punched in sections with their paper insulations. The sections break joint to equalize the reluctance and are strung true on through bolts that clamp them up between a deep internal flange and a stiff cast-iron end ring built in sections. The complete stator weighs 75,800 lbs.

Each coil is fully insulated, dried and tested to 15,000 volts before being inserted in the slots, the stator when completed being adequately tested. Special ventilation ducts are provided, the rotating field forcing cool air through these ducts and out at apertures cored in the frame. The winding of each phase is distributed over two slots per pole. The connection is star, with center earthed. The stator terminals consist of three high tension porcelain pots carried on a bracket at the bottom of the frame and inclosing the bare couplings. In each alternator provision is made for shifting the stator axially by ratchet jacks to clear

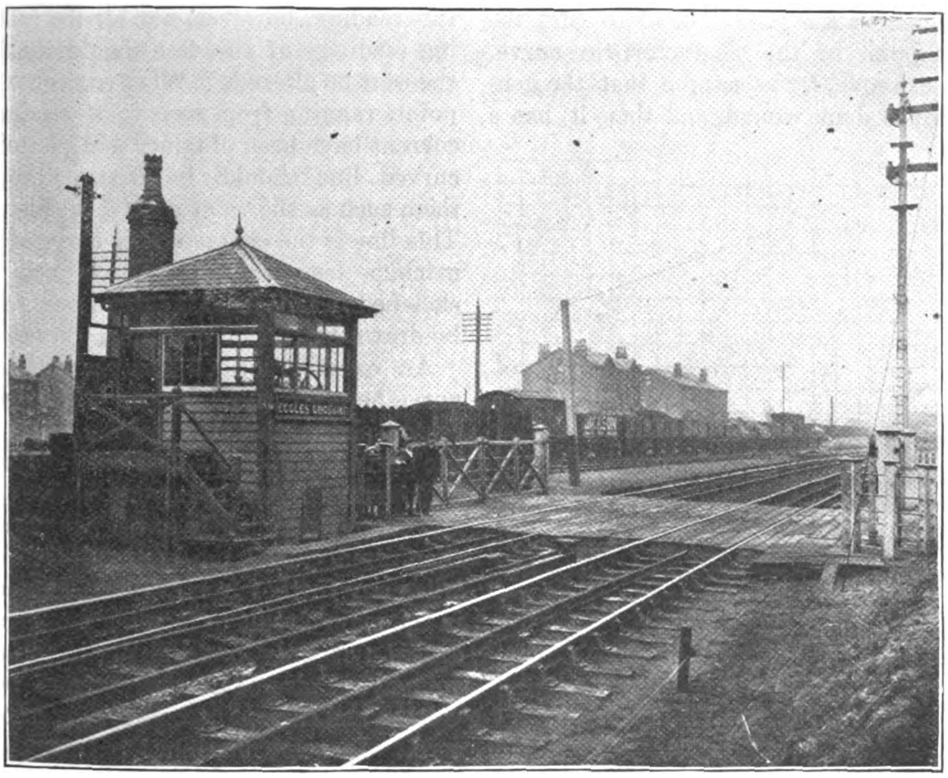
the rotor and give comfortable access to the windings.

There is also a fifth engine, a vertical cross compound (23 x 46 inch cylinders x 3 feet 6 inch stroke, developing 1,180 hp. at 94 revolutions per minute) driving a 750 kw. alternator of almost identical construction to the larger sets.

There are three Dick, Kerr–Willans & Robinson direct current exciters, four poles, 100 kw., running at 380 revolutions, the working voltage being 125. These machines also light the station and work the ash conveyor and bearing motors.

bracket with rotary converter bus-bar voltmeter and paralleling voltmeter; all the substation gear being for the local substation at Formby.

The whole of the high tension switch gear, oil switches, instrument transformers and bus-bars are erected in a fireproof H. T. chamber, the dimensions of which are 79 feet x 12 feet, and constructed of steel girders and concrete. Connection between the terminals of each stator and its oil switch is made by short leads to a trifurcating box in the pit, thence by a three core H. T. lead covered



Eccles Crossing, with Break in Conductor Rails, on the Liverpool-Southport Railway.

The main switchboard is erected on a gallery over a fireproof high tension chamber, and is built up of thirty-three 2 foot panels of enameled slate. Starting from the right there are swing brackets carrying two alternating current bus-bar voltmeters reading to 8,000 volts, synchronizing voltmeter 0 to 16,000 volts and synchronograph with lamps. Five main alternator panels, one blank panel, one total station power panel, six high tension feeder panels for distant substations, three exciter panels, one substation total power received panel, four high tension substation transformer panels, one blank panel, four rotary converter direct current panels, one blank panel, one substation total power delivered panel, also comprising one sub-panel switch for starting rotary converter from direct current 600 volt bus-bars; four substation feeder panels; lastly, one station lighting and blower-motors' starting panel, and swing

cable passing along an independent duct through the foundation up to the cellar ceiling, along which it is run by ducts through the H. T. chamber floor, where it ends in a second trifurcating box on the wall. The rest of the H. T. wiring is by individual conductors. The three-core H. T. leads are of stranded copper cable, paper insulated and lead covered. The single cables are rubber insulated taped and braided; they were designed to pass a flash test of 25,000 volts between the phases and each to earth. The solid copper rod H. T. bus-bars are insulated in a similar manner, and reduced in section from alternators to local sub-station panels as power is tapped. The bus-bars and individual leads are carried on corrugated H. T. porcelain pots, connection between oil switch and bus-bar being made through a H. T. insulating or "hook switch." In the instrument transformers supplied with the ammeters by Messrs. Elliott Brothers the primary is simply a straight length of lead or bus-bar inclosed by the secondary and iron circuit. In the wattmeter current transformer supplied by the Stanley Wattmeter Company, with its meters, the primary consists of a few turns in series with a bus-bar. The voltmeter transformers were built by Messrs. Dick, Kerr & Co., Ltd., the voltmeters by Messrs. Elliott Brothers, who also supplied the panels for the main board, the switches and circuit breakers being made at the Preston Works.

In all cases the low tension secondary leads pass through the ceiling to the switchboard above.

The total alternating current power generated, before passing to the sub-station feeders is recorded in an integrating wattmeter. Connection to each triplet of transformers in the substation is made through a hook switch, oil switch and three cast-iron tail-end glands, bushed with corrugated porcelain bobbins, piercing the front wall of the chamber. Each transformer is single-phase split-phase and has two independent secondaries, the six of the triplet being grouped in double mesh to afford six phases for operating the rotary converters. Connection between the grouped secondaries and the six rotary slip rings is made through a pair of three-blade switches carried on a stand, on which is also placed the equalizer switch for the series field.

The chief feature of the alternating board is that the high tension current is confined to the pit below the board, this being effected by the long arm oil switches which are used throughout the system.

The rotor field rheostats are of massive construction, and consist of cast-iron grids insulated with hard micanite and assembled in frames forming layers in a vertical stack which open top and bottom for thorough ventilation.

(To be continued.)

ELECTRICAL STATION PRACTICE.

ARTICLE XXXI.

BY W. H. RADCLIFFE.

In the operation of electrical stations, many problems dealing with the generators installed can be readily solved by the aid of characteristic curves, which curves bear practically the same relation to the generators as do indicator diagrams to steam engines. In steam engineering, a man who did not fully understand the method of taking an indicator diagram would be considered as not in touch with this profession, and in electrical engineering the same would be true of one ignor-

ant of the method of obtaining characteristic curves.

The necessary arrangement or connection of the generator from which it is desired to obtain a characteristic curve consists in providing a constant motive power so that the machine may be run at a uniform speed, and when the field magnets of the generator are separately excited the field current from the outside source must also be maintained constant, preferably by a rheostat connected in the field of the auxiliary machine. It is also necessary in every case that means be provided for varying the main current step by step from zero to maximum. This may best be done by employing a water rheostat. A convenient form of water rheostat consists of an iron tank containing a super-saturated solution of salt and water into which an iron plate may be raised or lowered at will. One of the main conductors from the generator is connected to the iron tank, and the other main conductor is joined to an ammeter, circuit breaker, and the iron plate connected in series. The iron tank should rest upon wooden planks placed upon the floor, and the movable iron plate should be supported by a heavy rope which must be led over two elevated pulleys one of which should be mounted directly above the center of the tank and the other at the same height but several feet distant from it. The free end of the rope should be weighted so that the iron plate may readily be moved up and down in the salt solution contained within the tank. In order that the characteristic curves obtained from shunt wound machines be of the most practical value, the curves should commence at the point of rated voltage for no load, thereby necessitating for each case a rheostat in series with the shunt field winding.

The measuring instruments that will ordinarily be required, in conducting the test for a characteristic curve, are a voltmeter connected across the armature terminals, an ammeter joined in series with the main circuit, and a portable tachometer applied directly to the end of the armature shaft for measuring its speed in revolutions per minute. During the test, one man should be assigned to the tachometer, another man to the water rheostat, and there should preferably be one man at each of the electrical measuring instruments In order to enable the man at the tachometer to keep the speed constant, he should be in communication either directly or indirectly with the source of the driving power, and the man at the water rheostat should be in plain view of the man reading the ammeter so that the latter party may signal him for the proper adjustment of the rheostat in order that the desired increase of current be obtained for each set of readings.

Having completed the preliminaries just mentioned, the test should be started with the main circuit of the generator open, that is, with the iron plate of the water rheostat raised above the solution in the tank. Then, in the case of the shunt machine, the speed should be made normal and the field rheostat adjusted until the voltmeter reading indicates the rated voltage of the machine at no load; sufficient data is then at hand to plot the first point of the characteristic curve. For example, let us assume that the generator is shunt wound, and that it has a

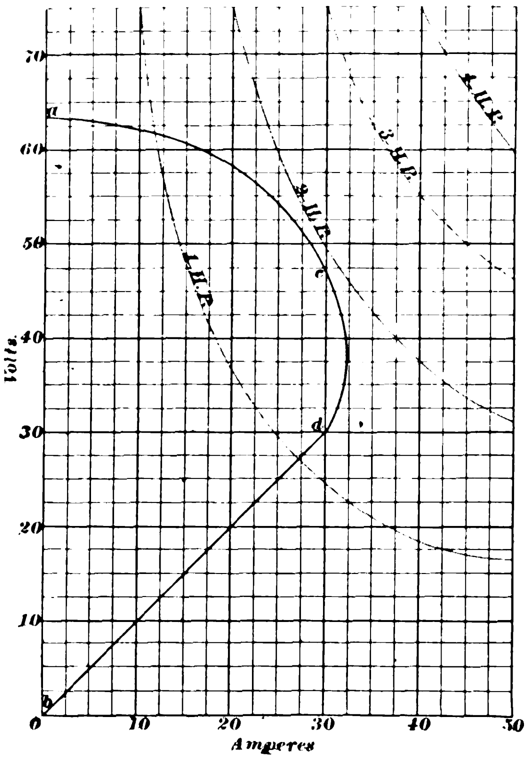


Fig. 30.

rated pressure of 63.5 volts at no load; 63.5 volts will then approximately be the maximum pressure this machine is capable of developing, since all of the current generated when the main circuit is opened passes through the field circuit. The current in the main circuit is, of course, zero, so upon a piece of co-ordinate paper ruled vertically and horizontally as in Fig. 30, these values should be plotted. It is customary to use the vertical lines or ordinates for representing the voltages, and the horizontal lines or abscissæ for representing the currents obtained in the test. Having assigned convenient values to the divisions on the co-ordinate paper for the case at hand, the plotting of the values just obtained (63.5 volts, 0 amperes) will give the point *a*. The iron plate of the rheostat should then be lowered so as to project an inch or so into the solution, and a second set of readings taken with the speed at its normal value and the rheostat in the position given it for the previous reading. Suppose the deflections on the meters when corrected by aid of the constants or curves of the meters as the case may be, give 62.5 volts and 7.5 amperes; the plotting of these values will give another point for the curve. A still further lowering of the plate will permit a stronger current in the main circuit, and the value of this together with its corresponding voltage will give a third point for the curve. Neither for this reading, however, nor for the following readings of the test should the field rheostat be altered. When six or eight points ranging from zero to a maximum current have been obtained and plotted, a curved line should be drawn through them such as shown at *a c d b* in Fig. 30. This line is the characteristic curve of the machine tested, and while it may be sketched in free-hand it should preferably be drawn by the aid of French curves.

An examination of the characteristic curve here presented for the shunt generator, shows that the highest point of the curve occurs at no load or 0 amperes, that as the current is increased the voltage drops first slightly to the point *c*, and then rapidly until the point *d* is reached when any further lowering of resistance in the main circuit to increase the current causes not only a rapid decline in the voltage but also of the current until both voltage and current become approximately zero. In some machines a very slight current results even when the terminals of the machine are actually short-circuited, that is due to residual magnetism in the pole pieces, so that the lower portion of the curve often terminates not exactly at zero but at a point some distance along the current line. The working portion of the curve is from *a* and *c* at which time the machine is supplying a fairly constant voltage. From *c* and *d* shows a critical condition of affairs, while the straight portion *d b* represents the unstable part of the curve caused by the field current being below its proper value. The position of the point *c* determines the maximum power the machine is capable of developing, being in the case cited 47.5 volts and 30 amperes. This is

$$\frac{47.5 \times 30}{746} = 1.91 \text{ hp.}$$

In order to tell at a glance the approximate amount of work a generator is performing at any given output or load, it is often convenient to draw on the co-ordinate paper certain horse power lines as has

been done in Fig. 30. The manner in which they are determined is simple. The 1 hp. line represents 746 watts; therefore, if a certain number of amperes represented on the abscissæ line be divided into 746 the result will be the number of volts which, if plotted above the value of amperes selected, will give one point on the 1 hp. line Other points obtained in the same manner determine the course of this line. The same method is followed for the 2 hp. line except in place of dividing into 746, twice 746 or 1,492 is used, and for the 3 hp. line three times 746 or 2,238 is the dividend.

The general form of characteristic curve that may be expected from a series generator is shown at *o a* in Fig. 31. It is obtained

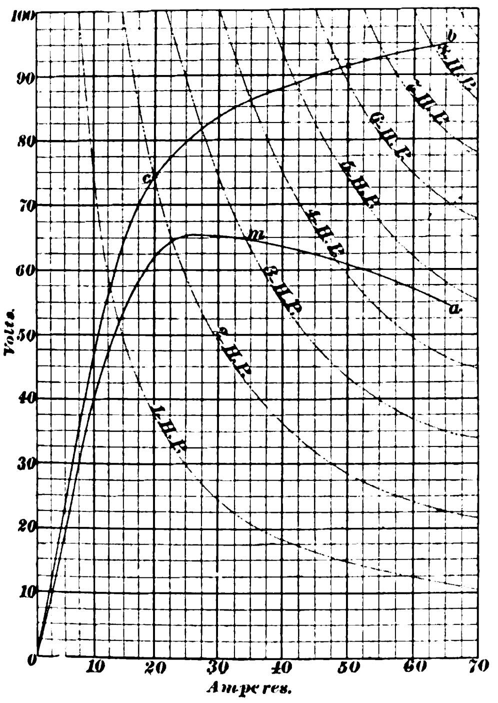


FIG. 31.

practically in the same manner as previously described for ascertaining the data for the shunt characteristic curve, except that no field rheostat is employed. Commencing with no load or amperes, that is, with the iron plate of the water rheostat raised out of the contents of the iron tank, there will probably be a small deflection noticeable on the voltmeter. At first thought, one would suppose that since the main circuit is open there would be no current through the field winding and therefore no voltage at this point, but if the reader bears in mind that there is always more or less residual magnetism in the magnet poles of a generator after once in service, he can readily account for the few volts noticeable. Whatever this reading may be, it should be recorded and plotted as in Fig. 31. Then the iron plate should be lowered so as to project slightly into the salt solution and the next set of readings taken and plotted, and so on as in the case of the shunt generator. The curve *o a*, Fig. 31, which represents this procedure for a certain series generator is practically a straight line at the beginning, representing thereby a proportional increase of voltage with increase of current, but after a certain current is reached (about 20 amperes for the machine here depicted) the curve flattens and takes a downward direction.

The turning point occurs in the characteristic curves of all series generators, and it denotes the stage at which the iron magnet cores become so saturated with lines of magnetic force that they will not readily allow more to pass through them; this turning point is technically known as the point of saturation, and the current corresponding (20 amperes in this case) is called the critical current of the generator. The point of saturation in any given series machine is governed by the amount of iron in the magnetic circuit; its position in the curve therefore varies according to the design of the generator as does also the critical current. The value of the latter is important inasmuch as the valuable features of a series generator assert themselves only when the machine is supplying a greater number of amperes than that of the critical current, for if the series generator be worked along that part *m a* of the curve to the right of the point of saturation it becomes nearly self-regulating as regards current, because as the current increases the voltage drops.

In Fig. 31 in addition to the characteristic curve *o a*, which may more definitely be called an external characteristic curve on account of representing the conditions external to the generator, there is shown a total characteristic curve, *o c b*. The latter curve represents the relation between the current and the total voltage developed in the armature, and may be plotted from the external characteristic curve if the resistance of the armature between brushes and the resistance of the series field winding be known. For example let us assume these combined resistances amount to .6 ohm. At 30 amperes there would be required $30 \times .6 = 18$ volts to force this current through the armature and field windings. At 30 amperes the external pressure is 65 volts, as shown by the curves *o a*; the total voltage developed for 30 amperes is, therefore, the external voltage plus the internal voltage or $65 + 18 = 83$ volts. Plotting 83 volts for 30 amperes will give one point for the external characteristic curve of this machine, and by determining in like manner the total voltages developed for six or eight different currents over the scale, sufficient data will be at hand for plotting and drawing in the curve *o c b*. Horse power lines have also been drawn in Fig. 31 according to the method already described. From these it is seen that the generator develops about 2 hp. at 20 amperes, about 4 hp. at 35 amperes, and about 7 hp. at 55 amperes.

The characteristic curve of a compound generator, if over-compounded, follows the general trend of that shown in Fig. 32 at *a b*, which curve was obtained from a machine over-compounded from 118 to 123 volts, and designed to give 203 amperes at full load. The preliminary arrangements for this test are similar to those for a shunt generator, and if the shunt across the series field winding is already made up and in position, the readings are taken precisely in the same manner. It is generally considered sufficient if observations are recorded at 0, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and full load. If it is desired to ascertain the effect which residual magnetism has upon the field magnets, the current is decreased after the full load point is reached without opening the circuit, and readings are taken in succession at $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{4}$ and 0 load. This was done in the case illustrated in Fig. 32, and the readings plotted gave the curve *b c d e s*. It is thus seen that residual magnetism exerts no small effect upon the voltage obtained at the different loads, for had there been no residual magnetism in the field magnets the curve *b c d e s* would have coincided with the curve *a b*. The curve *a b*, and the straight line *a x* drawn through the points *a* and *b*, are almost identical, and as *a x* respresents the theoretical characteristic curve for the machine, it is seen the compounding is practically perfect. In order to insure such accurate results being obtained, providing the machinery is correctly designed, requires considerable care in taking the readings; for example, each step or load on the ascending curve should not be exceeded before the corresponding deflection is taken, else the residual magnetism will cause the reading to be higher than it actually should be, and the following readings will also be affected in the same manner.

In case the shunt to be employed across the series field has not been made up, it is advisable to perform a trial test before taking the readings for the curve as previously described. The trial test consists in taking two readings—one at no load and the other at full load—the shunt being so adjusted as to length and section that the desired amount of compounding will be obtained in the latter reading with normal voltage at no load. If the first trial fails to produce the desired result by

giving too low a voltage at full load, the length of the shunt across the series field should be increased, or its section should be reduced by employing a less number of strips in its makeup; on the other hand, if the voltage at full load is higher than that desired, there must be made a decrease of length or an increase of section in the shunt employed. After each full load reading in this trial test it is necessary to entirely remove the load and then open the shunt field circuit in order to eliminate both the effects of residual magnetism and obtain the rated or normal voltage at no load for the following test.

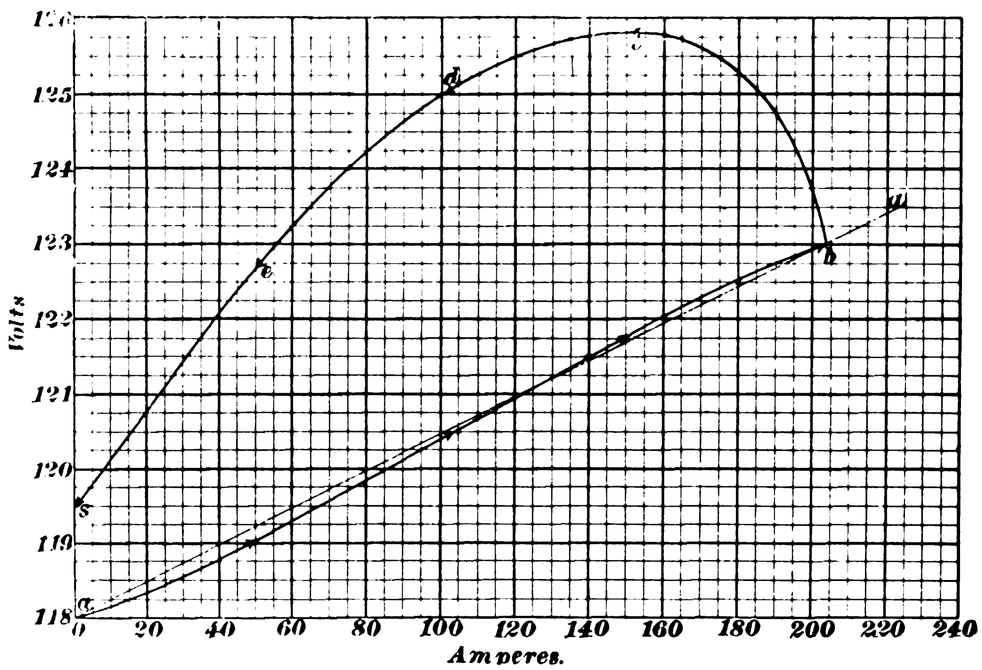


FIG. 32.

FURNISHING TIME BY TELEGRAPH.

One of the important functions of the United States Naval Observatory, located at Washington, D. C., is the furnishing of standard time to the country at large through the medium of the telegraph. During the last fiscal year the time service sent regularly daily telegraphic time signals at noon, 75th meridian time, with an average error for the year of only 0s.15. The widespread importance of this service is shown by the fact that it furnishes absolute standard time not only for navigators at all the principal seaports, but for the entire country except the Pacific coast, which gets a similar signal from the Naval Observatory at the Mare Island, Cal., Navy Yard. Moreover, all of this invaluable service is rendered the country at no expense whatever to the Government, inasmuch as it is merely incidental to the work, and the facilities required for the rating of chronometers for naval vessels.

To illustrate the wide distribution of this time signal, it is of interest to record the fact that it goes out daily over the wires of the Western Union, the Postal Telegraph, the American Telephone & Telegraph Company, the electrical department of the District of Columbia, and the National Electric Supply Company. There are now 18 Government time-balls and some 40,000 public and private clocks corrected daily by naval time signals. The wires of the American Telephone & Telegraph Company and of the electrical department of the District of Columbia were connected during the past fiscal year, and an arrangement has been made, by means of an electric sounder in the telephone room, to give the exact time by telephone any time of day or night to anyone who calls up the Observatory.

Shortly before New Year's Day a suggestion was made to the telegraph companies that they transmit the usual series of signals to end at midnight and thus announce the exact moment of the beginning of the new year. The Western Union took up the matter with great interest and energy, and the series of signals was sent out at midnight, 1, 2 and 3 A.M., so that each great section of the country might get its own midnight signal direct from the Naval Observatory at Washington. The plan was carried out very successfully and elicited so much general interest that it seems advisable to repeat it every New Year's eve hereafter, and officials of the Naval Observatory have further recommended that an effort be made, by eliciting the co-operation of other telegraph and cable companies, to send it all over North and South America, to our most distant colonies, and perhaps around the world, wherever telegraphs and cables extend and the necessary co-operation can be secured.

The receipt of the midnight signal was accurately timed at the Lick Observatory in California, and a report made to the Naval Observatory in Washington showed that it took but 0s.06 in transmission. The fact that this suggestion by the Observatory was taken up so willingly and the results greeted with such enthusiasm shows how strongly it appealed to the sentiment of the country, and if such sentiment be strong enough to enlist the co-operation of telegraph and cable companies to send similar signals around the world next New Year's eve, it seems well worthy of the slight trouble required on the part of the Observatory. Although such signals cannot be transmitted automatically from land lines to long cable lines, and vice versa, yet with expert manual transmission there need be little or no delay, and barring accidents, the midnight signal could doubtless be sent around the world and back to the Observatory in a very few seconds of time. Such a New Year's greeting from Washington to the entire civilized world, sent out officially, but carried everywhere by public-spirited co-operation of private companies, would have a powerful, even if only sentimental, influence.

A similar experiment was tried at 9 P.M. on June 15 last, upon the occasion of the visit of the executive board of the Observatory, in order to illustrate the possibilities of the time service as perfected by the Observatory in co-operation with the Western Union. The signals were sent all over the United States and even beyond its limits, to Toronto, the City of Mexico, Havana, and thence to San Juan and Kingston, Jamaica. A report from the Toronto Observatory the following day stated that it was timed there, and agreed within 0s.20 of their standard clocks. This experiment, together with the fact that our daily noon signals are now sent regularly to Havana over the short cable from Key West, shows that time balls can be established at all of our naval stations in the West Indies and dropped regularly by the noon signal from the Naval Observatory.

Wireless Telegraph With Port Arthur.

It is understood that negotiations are about to begin through Pekin for the purpose of arranging wireless telegraph communication with Port Arthur from a small rocky island off Cheefoo, which was acquired by France after the war of 1884-85, in which France, Great Britain and China were involved.

STANDARD PRACTICE IN THE USE OF ALTERNATING CURRENT ELECTRICAL APPARATUS.*

BY J. J. GIBSON.

(*Continued from page 179.*)

Let us now turn to the electric system. The alternators must run at absolutely the same velocity since they are in parallel, but the electric circuit by which they are connected has an elasticity similar to the elasticity which I spoke of in the shaft in Fig. 2. This permits of the two armatures differing slightly in angular position, but when in such a position currents flow from one machine to the other, which tend to pull the lagging machine up to the mean position, and we have the same process of transmission of load and the possibility of oscillation as we had in the mechanical analogy. A mechanical analogy has been used in order to show that the problem is purely a mechanical one, for the alternators create no power; they simply transform and transmit the power which they receive. If they give varying power to their circuits it is because they are receiving varying power from the engines which drive them.

Let us now consider the engine requirements which are necessary to prevent the troubles pointed out.

First—The engine governor should be so constructed that there is no tendency to cause this periodic transfer or surging of the load between one engine and another. All reciprocating engines have an angular variation of velocity in different parts of the revolution. Either this or a sudden variation of load will affect the governor, or other causes may lead to non-uniformity of speed. The engine governor should not be sensitive to such disturbances. It should not maintain or increase them. The effect of periodic transfer of load occasioned by hunting, caused by two engines running in parallel, is somewhat similar in effect to throwing the load on or off of a single engine at short, equal intervals measured by one or several pulsations in the combined turning efforts applied to an engine shaft. The point is that, in case of pulsating load, the engines must not tend to accentuate the pulsations in turning effort and speed.

Engine governors may be made to meet these requirements in some cases by the application of dash pots, so that there is resistance to any very sudden movement of the governor, although if the tendency to move is continued for a sufficient length of time the resistance of the dash pot is lessened and the movement rendered possible. On the other hand, under certain conditions, dash pots are not necessary. The period of the governor may be changed by changing the value of the adjusting weight and its distance on the lever, thus retaining the same moment but changing the moment of inertia and consequently the natural period of the governor.

In engines of large size governors are very frequently furnished with a simple reversing motor of the direct current type, which is arranged to screw up or down a spring attached to the governor weight, the motor being started, stopped or reversed from the switchboard by a simple switch. This permits bringing an unloaded unit up to speed so as to throw it in parallel with loaded units and afterwards enables the control of speed so that the unloaded unit can assume its share of the load after being put into speed. It also permits of relieving a unit of a load so that it may be put out of service.

On account of the impossibility of predicting the conditions in practice in any installation, the engine governor should be readily adjustable.

Second—The variation of the rotating part of the generator through a revolution at any constant load not exceeding 25 per cent. overload, should not exceed one-sixtieth of the pitch angle between any two consecutive poles from the position it would have if the motion were absolutely uniform at the same mean velocity. The maximum permissible variation, i. e., the amount the rotating part forges ahead plus that which it lags behind the position of uniform rotation is one-thirtieth of the pitch angle between two poles. In a 2-pole machine this variation is equivalent to 3 degrees as measured on the circumference of the rotating part. In the 4-pole it is 1½ degrees; in a 6-pole machine 1 degree. The greater the number of poles the smaller the permissible angular variation. Incidentally it follows that the lower the frequency of the machine the better the conditions for parallel operation. This requirement of uniform rotation is usually obtained by the use of a heavy fly-wheel. Too great weight in a fly-wheel is not a good thing, for it adds to the pendulum effect by causing the governor to act longer than it should. The engine fly-wheel, therefore, should be no heavier than is necessary. Multi-crank engines, by reason of the fact that there are more impulses per revolution, give more satisfactory conditions. Of two crank engines the twin engine, non-compound in parallel, operates most easily. A cross-compound engine cannot be made to accurately divide the load between the two cylinders over wide ranges. It is, therefore, more difficult to operate than the twin engine, but it is a type which does not require an excessive fly-wheel and is much better than the tandem compound. Vertical engines require larger fly-wheels than the horizontals on account of irregularity in the forces producing rotation introduced by the weights of reciprocating parts.

But as we go on to three crank engines steam distribution introduces complications, although we are increasing the impulses per revolution. An engine which is giving excellent results is the double horizontal vertical engine, giving eight impulses per revolution. This type of engine is used in the 5,000 kw. units in the power house of the Manhattan Railway, New York City.

Third—Similar characteristics of speed regulation are essential in the engines, so that their respective generators may properly divide the load. It is better, therefore, that the speed should drop from 3 to 5 per cent. from full load to no load than there should be very close regulation, such as 1 to 2 per cent. A diagram will illustrate this point. Referring to Fig. 3, let us lay off loads on

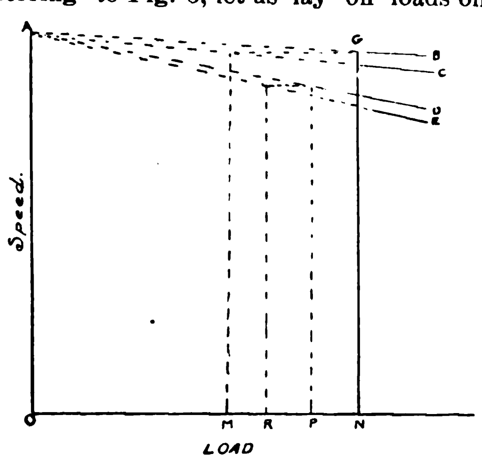


FIG. 3.

horizontal axis and speeds on a vertical axis. We will let the line A-B and the line A-C be the speed characteristics of two engines. We will say that at the load corresponding with the point N on each engine that the difference in speed corresponds to the vertical distances between the characteristic lines, as measured on the line G-N. Now the engines must run at the same speed since their alternators are in parallel; therefore, when the engine corresponding to the line A-B is carrying the load corresponding to O-N, the engine represented by the characteristic A-C is bound to be carrying the load corresponding to O-M.

Let us now suppose that both engines

*Paper read at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

have a greater drop in speed from no load to full load and that the new characteristics be the lines A-D and A-E. As before, one has a slightly greater drop than the other in speed for the same load, but since they must run at the same speed, the load in this case divides itself as shown, the engine corresponding to characteristic A-D carries a load corresponding to O-P; the engine corresponding to the characteristic A-E carries the load O-R.

This diagram, therefore, illustrates the fact that the distribution of load would be more even between the engines having the greater drop in speed than between the engines having the smaller drop in speed.

(*To be continued.*)

INTERNATIONAL ELECTRICAL CONGRESS RECEPTION COMMITTEE.

The first meeting of the International Electrical Congresss Reception Committee of the American Institute of Electrical Engineers was held at 12 West 31st street, Thursday evening, March 24. A large representation of the committee was presented, also Mr. George G. Ward, local honorary secretary of the Institution of Electrical Engineers, members of the board of directors, and members of the transportation committee, who had been invited to attend.

Chairman Lieb proposed the itinerary for the tour of the European visitors.

The details of the tour as suggested were thoroughly discussed, and while there was a feeling that it would be a severe tax upon the visitors, it was difficult to see how the trip could be curtailed without omitting some desirable and important features.

In the course of the discussion it was pointed out that possibly some arrangement could be made by which those who desired to extend their trips beyond St. Louis, or spend a longer period at the Exposition, would be able to return independently upon the regular excursion ticket that will be provided. It was accordingly voted that the committee be thanked for the programme as outlined, and that it be accepted with the recommendation that, if possible, the chairman of the transportation committee should arrange that there be some plan adopted by which as many sleeping cars as might be necessary would be provided for the special train on the return trip, and that such persons as desired have the privilege of alternative return routes on regular trains. In case this cannot be arranged, the plan to be adopted is as presented below.

The following executive committee was appointed: John W. Lieb, Jr., chairman; Frank J. Sprague, vice-chairman; J. C. Barclay, J. J. Carty, F. W. Jones, H. Ward Leonard, E. H. Mullin, L. B. Stillwell, H. G. Stott, Calvert Townley, Gerge G. Ward, J. G. White.

Local committees at the various points to be visited will be subsequently announced by the chairman.

THE ITINERARY.

The foreign guests of the Institute, including the British Institution of Electrical Engineers, who are the official guests of the American Institute of Electrical Engineers, the representatives of the Associazione Elettrotecnica Italiana and representatives of other foreign technical bodies and unattached delegates, are expected to arrive in New York previous to September 3. After this date the itinerary will be as follows:

Sunday, September 4, New York City—This day will be spent in a steamer ride up the Hudson River, possibly as far as West Point, giving the visitors an opportunity of seeing the beauties of the river and the surroundings of New York City.

Monday, September 5—The visitors will be entertained by the corporations representing the electrical industries of New York City, including a visit to the power houses of the Rapid Transit Subway Company, the Manhattan Railway Company, the Metropolitan Street Railway Company, the New York Edison Company, the exchanges of the New York Telephone Company and other points of engineering interest. In the evening there will be a formal reception of the foreign visitors under the auspices of the American Institute of Electrical Engineers.

Tuesday, September 6, Schenectady, N. Y.—The party will leave New York on Tuesday morning for Schenectady, where they will be received and entertained by the General Electric Company, leaving for Albany in the afternoon; leave Albany in the evening for all-night trip to Montreal.

Wednesday, September 7, and Thursday, September 8, Montreal, Canada—Reception at McGill University, and visits to the important power transmission plants in the vicinity, leaving Montreal Thursday evening by boat or train for Niagara Falls.

Friday, September 9, Niagara Falls, N. Y.—Visit to the Falls and the important power houses and electrical industries of the locality. Leave Niagara Falls Friday evening for Chicago, arriving Saturday morning,

Saturday, September 10, Chicago, Ill.—Visits to important power houses and local points of interest. Leave Chicago Saturday evening for St. Louis, traveling all night.

Sunday, September 11, St. Louis, Mo.—To be spent in St. Louis resting, etc.

Monday, September 12—Opening of the International Electrical Congress at 10 o'clock A.M., with joint sessions of all of the sections.

Wednesday, September 14—Special joint session between the American Institute of Electrical Engineers and the British Institution of Electrical Engineers, to which all foreign guests are invited.

September, 13, 14, 15 and 16.—Sessions of the various sections of the Congress with sessions each day from 9 to 12 A.M., and from 1:30 to 4:30 P.M,

Saturday, September 17—Closing general sessions in the afternoon of all sections of the International Electrical Congress. Leave St. Louis during night for Pittsburg, arriving late Sunday afternoon.

Monday, September 19, Pittsburg, Pa.—Reception and entertainment by the Westinghouse Company, and visits to important and interesting local industries. Leave Pittsburg Monday night and arrive at Washington Tuesday morning.

Tuesday, September 20, Washington, D. C.—Inauguration of the National Bureau of Standards at Washington and visits to places of local interest.

Wednesday, September 21, Philadelphia, Pa.—Visits to important power houses and points of interest. Leave Philadelphia for Boston in the afternoon via boat, Fall River Line.

Thursday, September 22, Boston, Mass.—Visits to power houses, Harvard University, Massachusetts Institute of Technology and places of local interest. Leave Boston Thursday night for New York, by boat.

Friday, September 23—Unassigned.

Saturday, September 24—Return home by some of the party.

False Report About a Municipal Plant.

Editor ELECTRICITY.

SIR: We notice in the issue of your valuable publication of March 23, under "Lighting" on page 167, an item in reference to Hancock, Mich., as follows: "The citizens voted favorably on the proposition to build a municipal electric light plant next month." Of course, we do not know the source of your information, but the information given in the

item referred to is a long way from the truth. There was, some time ago, a petition presented to the city council of Hancock, which was signed by a local labor union to put the question to a vote of the people on April 4, which is the annual election. No action was taken on this petition and the election warrants, already posted, do not contain anything referring to a municipal plant.

Yours very truly,

HOUGHTON COUNTY ELECTRIC LIGHT CO.

Houghton, Mich., March 29, 1904.

American Institute Officers.

The board of directors of the American Institute of Electrical Engineers, at the last meeting in this city, placed in nomination the following ticket containing the names of the proposed officers to be voted on at the annual meeting in May:

For president—John W. Lieb, Jr., New York.

For vice-presidents—W. E. Goldsborough, St. Louis; John J. Carty, New York; Samuel Reber, Washington, D. C.

For managers—Henry G. Stott, New York; Louis A. Ferguson, Chicago; J. G. White, New York; S. S. Wheeler, Ampere, N. J.

For treasurer—George A. Hamilton, New York.

For secretary—Ralph W. Pope, New York.

The directors' nominations are usually equivalent to an election.

Standard Underground Company's St. Louis Office.

The Standard Underground Cable Company announces the recent opening of a branch office or headquarters in the security Building, St. Louis, Mo., in charge of Mr. W. A. Caldwell, who was formerly connected with the Chicago office of the company, but more recently with the home office at Pittsburg. Mr. Caldwell had a number of years' experience with the company in both the construction and sales departments.

This enterprising company has now seven district or branch offices throughout the country, covering the whole of it from Maine to California, namely: Northeastern sales department, Delta Building, Boston; Eastern sales department, 56 Liberty street, New York City; Southeastern sales department, Betz Building, Philadelphia; Central sales department, Westinghouse Building, Pittsburg; Western sales department, Rookery Building, Chicago; Southwestern sales department, Security Building, St. Louis, and the Pacific Coast sales department, Crossley Building, San Francisco.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 29, 1904.

Electric Railways and Appliances.

755,770. Traction-Engine Wheel. Amos Harrold, Newark, O. Filed Nov. 11, 1903.

755,788. Car-Fender. Albert E. McLean, Toronto, Can. Filed Dec. 30, 1903.

755,794. Fender. Charles H. Root, Cleveland, O. Filed Aug. 3, 1903.

755,822. Train-Control System. George P. Whittlesey, Washington, D. C., assignor to the General Electric Company. Filed Sept. 26, 1902.

755,825. Railway-Brake Apparatus. Granville T. Woods and Lyates Woods, New York City, assignors, by direct and mesne assignments, to the Westinghouse Electric & Manufacturing Company, Filed Dec. 31, 1902.

755,872. Car-Fender. James T. Heron and John J. Crowley, New Bedford, Mass. Filed Jan. 6, 1904.

755,899. Electric-Railway System. Timothy Mahoney, San Francisco, Cal. Filed April 20, 1903.

755,905. Electric-Traction System for Railways. August Meuschel, Montreal, Can. Filed May 4, 1903.

755,999. Electric-Trolley Head. John T. Cherry, Plymouth, and Edward H. Clive, Devonport, Eng. Filed Nov. 3, 1902.

756,060. Car-Fender. Frank A. Schaaf, Cleveland, O. Filed March 14, 1903.

756,156. Signal Apparatus for Trolley-Railways. Almo L. Cheatham, Louisville, Ky., assignor of three-fourths to Robert V. Cheatham, same place. Filed Aug. 8, 1903.

Electric Lights and Appliances.

755,697. Electric-Incandescent-Lamp Socket. Guy H. Proctor and John B. Daley, Somerville, Mass., assignors to the New England Electric Manufacturing Company, same place. Filed July 30, 1903.

755,797. Arc-Lamp Hanger. Howard R. Sargent, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 2, 1902.

755,815. Electric-Arc Lamp. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed Aug. 19, 1901.

755,855. Globe-Holder for Arc-Lamps. Samuel E. Doane, Cleveland, O., assignor to the Fostoria Bulb & Bottle Company, Fostoria, O. Filed June 24, 1903.

755,914. Means for Adjusting Lamps. Walter G. Morse, Waterbury, Conn. Filed Nov. 7, 1903.

755,954. Electric Lamp and Socket. Albert N. Soden, Trenton, N. J. Filed Dec. 10, 1902.

756,025. Electric-Light-Circuit Protector. Stanley Kalbach, Wildwood, N. J. Filed May 12, 1902.

756,049. Switch for Incandescent Electric Lamps. Conrad M. Pitel, Meriden, Conn. Filed Nov. 23, 1903.

756,050. Coupling for Incandescent Electric Hanging or Suspension Lamps. Conrad M. Pitel, Meriden, Conn. Filed Nov. 23, 1903.

756,117. Electric-Lamp Support for Convertible Signal-Lanterns. Louis H. W. Kerber, Chicago, Ill., assignor to the Adams & Westlake Company of Illinois. Filed May 13, 1903.

Electrical Machinery and Apparatus.

755,635. Transmission Mechanism. George Dillig and Henry P. Dillig, Millvale, Pa. Filed May 8, 1903.

755,731. Controller for Electric Motors. Magnus W. Alexander, Lynn, Mass., assignor to the General Electric Company. Filed June 13, 1903.

755,732. Electric Motor. Ralph E. Barker, Lynn, Mass., assignor to the General Electric Company. Filed Aug. 7, 1903.

755,733. Motor. Thomas Barrow, Plainfield, N. J., assignor to the Pedrick & Ayer Company, same place. Filed Jan. 8, 1903.

755,739. Maximum-Demand Indicator. Harry W. Brown, Boston, Mass., assignor to the General Electric Company. Filed Aug. 2, 1902.

755,744. Controller. Frank E. Case, Schenectady, N.Y., assignor to the General Electric Company. Filed Oct. 1, 1902.

755,750. Emergency-Brake. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed July 16, 1903.

755,751. Motorman's or Engineer's Valve. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 13, 1903.

755,757. Multiple-Rate Meter. Alexander J. R. Fiego, Lynn, Mass., assignor to the General Electric Company. Filed July 21, 1903.

755,766. Transformer. Walter A. Hall, Lynn, Mass., assignor to the General Electric Company. Filed Sept. 29, 1902.

755,771. Electric Switch or Circuit-Breaker. Edward M Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 29, 1900. Renewed May 7, 1902.

755,791. Means for Closing Field-Circuits of Rotary Converters. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 17, 1903.

755,817. Electrical Igniting Mechanism for Explosive-Engines. Daniel M. Tuttle, William H. Lindley and William H. Tuttle, Canastota, N. Y. Filed Oct. 27, 1902.

755,819. Induction Motor. Pendleton G. Watmough, Jr., Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 2, 1902.

755,824. Means for Starting Alternating-Current Dynamo Electric Machines. Jonathan E. Woodbridge, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 11, 1901.

755,827. Rheostat. William C. Yates and Paul Zimmer, Schenectady, N. Y., assignors to the General Electric Company. Filed July 25, 1903.

755,828. Rheostat. William C. Yates, Schenectady, N. Y., assignor to the General Electric Company, Filed Aug. 22, 1903.

755,829. Controlling Induction Motors. Arnaldo P. Zani, Milan, Italy, assignor to the General Electric Company. Filed June 30, 1900.

755,845. Electric Time Switch. Frank W. Cherry and Henry F. Radke, San Francisco, Cal. Filed Jan. 25, 1902.

756,026. Insulator. William S. Kinsley and Stewart S. Bell, Reading, Mass. Filed Aug. 10, 1903.

756,045. Shunt Controller for Electric Machines. Nels O. Nelson, Chicago, Ill. Filed July 13, 1903.

756,167. Controlling Electric Boosters. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Original application filed Aug. 31, 1900. Divided and this application filed Oct. 20, 1902.

756,181. Insulator. Louis McCarthy, Boston, Mass. Filed Feb. 11, 1904.

Telephones and Telephone Apparatus.

755,691. Telephone Selective System. Noble S. McKinsey and Anton R. Nelson, Susanville, Cal. Filed June 15, 1903.

755,868. Telephone System. Robert Hamilton, Milton, Mass. Filed Feb. 7, 1903.

756,091. Telephone Cabinet. William B. Altick, Lancaster, Pa. Filed May 16, 1902.

756,183. Telephone Call Attachment. Jason J. Nye, Brookfield, Vt. Filed March 31, 1903.

Miscellaneous.

755,642. Electric Accumulator Plate. Chaimsonovitz P. Elieson, Paris, France. Filed Oct. 16, 1903.

755,646-755,647. Multiplex Telegraphy. Stephen D. Field, Stockbridge, Mass. Filed March 5, 1903; March 24, 1903.

755,659. Electric Water Heater. James F. Hathaway, San Francisco, Cal., assignor of two-thirds to Felix B. Mulgrew and Julius M. Alexander, same place. Filed Aug. 10, 1903.

755,669. Current Selector for Charging Secondary Batteries. Miller R. Hutchison, New York City, assignor, by mesne assignments, to the Hutchison Acoustic Company. Filed May 5, 1903.

755,740. System of Electrical Distribution. Harold W. Buck, Niagara Falls, N. Y., assignor to the General Electric Company. Filed Sept. 4. 1902.

755,774. Electric Clock. Frank Holden, London, Eng., assignor to the General Electric Company. Filed April 16, 1900.

755,775. System of Electrical Distribution. Lewis L. Holladay, Lynn, Mass., assignor to the General Electric Company. Filed Aug. 21, 1902.

755,782. Electrical Contact Device. John Lindall, Boston, Mass, Filed Oct. 8, 1903.

755,783. Electric Fire Alarm. August Lueckert, St. Louis, Mo. Filed Dec. 10, 1902.

755,830. Tub for Electric Baths. Josef Zwiebel, Neu-Ulm, Germany. Filed Nov. 24, 1903.

755,840. Detector for Electrical Disturbances. Jagadis C. Bose, Calcutta, India, assignor of one-half to Sara Chapman Bull, Cambridge, Mass. Filed Sept. 30, 1901.

755,853. Electric Power Transmission System. Max Deri, Vienna, Austria-Hungary, assignor to the Stanley Electric Manufacturing Company. Filed May 28, 1902.

755,890. Electric Signaling Device. Thomas C. Laney, Toledo, and Charles S. Longnecker, Delta, O. Filed Nov. 24, 1902.

755,897. Electric Lock. Frank Lombardi, Brooklyn, N. Y. Filed Dec. 19, 1903.

756,119. Electric Resistance. Hans von Kramer, Bath, Eng. Filed Sept. 1, 1903.

756,176. Protective Sheath or Envelop for Storage Battery Plates. Achille Meygret, Paris, France. Original application filed June 29, 1903. Divided and this application filed July 27, 1903.

THE TELEPHONE WORLD.

Cut In Bell Rates Will Not Affect Cuyahoga Company.

The announcement made by the Cleveland, O., Telephone Company, that it contemplates a reduction of the rates on the measured service, did not create any excitement in Independent telephone circles; however, it is taken that the Cleveland Telephone Company has, by this arrangement, made a bid for telephone service and change of rates with equanimity. President Dickson, of the Cuyahoga Company, says:

"This lowering of rates will not affect our recently issued schedule in the least. We expect to do an increased business steadily, regardless of the cut in traffic on the part of the opposition. The evidences are that the Cuyahoga Company is now in position with its improved equipment to afford strong competition to the Bell people here and they are getting scared. They have, however, begun at the wrong place to do us any damage. The only concessions they have made is on measured service. On their unlimited service the rates are the same as they have been for years past. Our limited service rates are still lower than theirs and our unlimited service rates are much lower than those offered by our competitors. Of course, under the circumstances, this will not necessitate that we make any change in our rates to meet the competition."

The new schedule of rates is as follows: To business houses one party rate of $15 per quarter for 300 calls, with a rebate of $1.50 for prompt payment; two-party line for $12, with a rebate of $1.50 for prompt payment, including 225 calls. For residences, one-party rate of $11.25 for 200 calls, with a rebate of $1.50 for prompt payment; a two-party line for $9 per quarter for 150 calls, with a rebate of $1.50 for prompt payment.

Each telephone company in St. Louis, Mo., has a World's Fair exchange. The Kinloch has eight trunk lines from the World's Fair to the city, and the Bell has ten. There are 68 telephones on the Bell exchange and 87 on the Kinloch, all the telephones being located in the Administration Building and on the grounds. Communication between different offices of the Fair is without the use of trunk lines, and the congestion on these is due solely to business from without.

The board of public works of Kansas City, Mo., has issued orders to the city treasurer to refund to the Home Telephone Company the $40,000 deposited by it as a guaranty that it would build and operate a telephone system in accordance with the terms of its franchise. City Electrician Haldeman and City Engineer Pike, who inspected the plant of the company, reported that the terms of the franchise had been complied with.

We are requested to publish the election of officers of the Adamsville, O., Telephone Company, as follows: President and manager, J. B. Rhodes; vice-president, C. H. Hanks; secretary, F. P, Winn; treasurer, M. F. Tomlinson; counsel, S. M. Winn.

The Carney Automatic Telephone Company of Carney, Okla., has been incorporated with a capitalization of $10,000.

Telephone Magnates Hold Meeting in Syracuse, N. Y.

Representatives of nearly all of the largest operating telephone companies in New York State were present at the annual meeting of the executive committee of the New York State Telephone Association held recently in Syracuse. The officers of the association are George R. Fuller, of Rochester, president; Howard Hendrickson, of Albany, vice-president; J. H. Scofield, of New York, second vice-president; Joseph B. Ware, of Buffalo, secretary and treasurer.

The meeting was called for the purpose of taking up the report of the special tariff committee appointed for establishing a general plan of handling the toll business of the State.

T. S. Lane, of Jamestown, was elected secretary and treasurer to fill the vacancy caused by the resignation of Joseph B. Ware, who has accepted a position in the West.

It was decided to hold the next annual meeting at Buffalo under the auspices of the Frontier, the Interocean and the Consolidated Telephone Companies. A special committee was named to look after the telephone toll service of the State, the idea being the establishment of a State clearing house. The meeting adjourned to convene in Syracuse within a month.

The annual meeting of the Woodsfield O., Telephone Company was lately held. The following directors were elected: J. B. Rhodes, W. E. Mallory, P. E. Fraley, L. E. Stegner and F. C. Huth. J. B. Rhodes was chosen president; W. E. Mallory, vice-president; P. E. Fraley, secretary and treasurer; F. C. Huth, general manager. The capital stock will be increased from $15,000 to $25,000, and a number of extensions and improvements made the coming summer.

A telephone system is to be inaugurated between Redding and Wengler, Cal., on the Big Bend of the Pit River. The line will run by way of Bella Vista and Ingot. A company has been formed with a capital stock of $10,000, with the following directors: Herbert Bass, of Montgomery Creek; Matthew Wengler, of Wengler; W. G. Scott, of Redding, and R. A. Ward and A. Berg, of Round Mountain.

The Wisconsin Telephone Company has submitted to the Milwaukee council a proposition to establish in the city hall a public telephone station. This company is installing telephones on the street corners of Milwaukee.

There are already more than 12,000 stations or telephones in the territory of the Providence, R. I., Telephone Company, and under the new efforts now being made to extend the service the number is increasing rapidly.

The Scotchtown, N. Y., Telephone Company, is a new concern, capitalized at $2,000. The directors are M. H, Santle, of Circleville, and W. R. Rockefellow and A. C. Santee, of Scotchtown.

Contracts for the Hudson River Telephone Company to extend its lines to White Church, N. Y., have been signed.

A telephone company is now established at Mio, Mich., capitalized at $2,000.

Old Rates for Michigan State Company.

William A. Jackson, president of the Michigan State Telephone Company of Detroit, states that it is not the intention of the reorganized concern to raise the rates of service in that city, nor is it the intention to take away from subscribers the privilege of using the old Blake transmitter, which costs but $54 a year if they choose to use it.

"We are merchants," said he, "and are anxious to please our customers. Like the grocer who wants to keep his trade, we much prefer to sell a man fresh eggs that we can guarantee, rather than old eggs which we cannot guarantee. That is why we recommend to everybody that he get the metallic service. It would be better for our subscribers. There would be more uniformity and less criticism of the telephone service. If a person cannot afford to pay the $72 rate, he can still use the so-called message rate, which gives him a certain number of calls per quarter, or he can get the two-party service. In this way he can reduce his telephone expenses to as low as $30 a year."

Western Rural Line.

A meeting of those interested in the extension of the telephone line from Huntsville, Wash., up Sorghum Hollow, was recently held, and they decided to at once construct the link, which will be about four miles north from Huntsville, and will accommodate several farmers. The cost of these lines, including wires, 'phones and labor, will not be over $150. The present line has connection with Waitsburg, Prescott and Alto, and the plan is to make connection with Dixie, where there is already a rural line to Walla Walla. There is also a line connecting with the Whisky Creek section. When the projected connections are made the whole section from Dayton to Walla Walla will be covered with these rural lines.

The Blue Earth County Telephone Company of Lake Crystal, Minn., has filed articles with $25,000 capital stock. Elliott Upson, of Judson, is president, and David E. Bowen, of Cambria, secretary.

Fred Windisch, of Port Clinton, O., has purchased the telephone exchange at Prairie Depot in that State and will remodel it at once.

The Delaware & Madison County Telephone Company has purchased the telephone exchange at Summitville, Ind.

Cornersville, Tenn., is to have a telephone exchange at an early date, a company having been organized at that place.

Telephone Incorporations.

The Conway Rural Telephone Company, Conway, Mo. Capital stock, $10,000.

The Tremont Independent Telephone Exchange, Tremont, Ill. Capital stock, $20,000. Incorporators: Aquilla J. Davis, Frank J. Davis and Walter H. Ames.

The Reading & Rock Stream Telephone & Telegraph Company, Watkins, N. Y. Capital stock, $10,000. Directors: Charles Chapman H. M. Smith and H. S. Howard, of Watkins.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Anderson, Ind.—The city electric light board has negotiated its first loan to pay on the cost of constructing the new electric light plant.

Ann Arbor, Mich.—The Michigan Milling Company has asked for an electric lighting and power franchise. It wants to develop power for commercial lighting.

Bryan, Tex.—The city council has granted to H. B. Dorsay a franchise to erect electric light wires and poles on Main street for the purpose of furnishing to the citizens lights, fans or other electrical appliances.

Chicago, Ill.—E. B. Ellicott, city electrician, asks for $200,000 appropriation for the extension of the municipal electric lighting plant. Many arc lamps would be replaced by city lamps.

Cicero, Ind.—The town board has granted a 25-year electric light franchise to John Plain.

Fairfax. S. D.—C. A. Johnson, president of the Fairfax State Bank, is making arrangements for furnishing the town with electric lights.

Fillmore, Utah.—It is reported that Mr. Winberg, of Milford, will erect an electric light plant here.

Fleetwood, Pa.—The borough council is talking of lighting the village with electric lights.

Fort Wayne, Ind.—The organization of the Fort Wayne Electric Light & Power Company has now been effected and the company will soon begin the reconstruction of the plant.

Ft. Worth, Tex.—Sam Rosen has asked the council for an electric light franchise here.

Glenns Ferry, Ida.—B. G. Mullins and others, of Napa, will erect an electric light and water plant here to cost $25,000.

Grand Rapids, Mich.—The municipal electric lighting plant will probably be enlarged to supply additional light in city buildings. Barney Meyer, superintendent, is interested.

Hamilton, O.—The city council has passed an ordinance for the issuance of $15,000 for a water plant, and $5,000 for electric light bonds.

Harvey, Ill.—The city council has closed a contract for electric lighting with the Calumet Lighting Company of Chicago for five years.

Harmon, Ill.—The electric light plant project is favored by the citizens.

London, Ky.—The London Electric Light Company has been incorporated with R. M. Jackson, president; J. B. Ederline, secretary, and W. F. Remer, general manager.

Minneapolis, Minn.—The Minneapolis Retailers' Association will establish an electric light plant of its own. W. L. Harris is one of the parties interested.

Monterey, Mex.—The Electric Light & Power Company will install machinery so as to double the number of incandescent lights for the city, and add many more arc lights and power for operating innumerable electric fans.

Ontario, Wis.—Herman Timmerman will put in an electric light plant here this summer.

Otsego, Mich.—The proposition to raise $2,500 to purchase the electric light plant was lately carried by a fair majority.

Philo, O.—Hon. C. U. Shryock, of Zanesville, has secured a franchise from this place for an electric lighting plant.

Pinckneyville, Ill.—The electric lighting plant, recently destroyed by fire, may be rebuilt. J. H. Ward is a local stockholder.

Presque Isle, Me.—The electric lighting and heating station owned by the Presque Isle Electric Light Company was lately burned.

Richmond, Cal.—The Richmond Electric Light Company will install a dynamo, also direct generator and motor combined.

San Diego, Cal.—An additional $7,000 has been allowed for the installation of an electric light plant at Fort Rosecrans.

Saybrook, Ill.—The town board has granted a 20-year franchise to Saylor Dres to operate an electric light and heating plant here.

Tallula, Ill.—A new electric light plant is to be installed soon.

Upper Alton, Ill.—An electric lighting plant may be jointly erected by the towns of Upper and North Alton.

Vacaville, Cal.—The matter of erecting an electric light plant is being talked of. F. A. Seiger, city engineer; S. G. Creighton, city clerk.

Victor, Col.—A number of merchants and property owners here have formed a company, which is already backed by nearly $3,000 of pledged capital, and will install an independent electric plant in this city.

Woodbury, Conn.—Work will soon begin on an electric light plant for this city and Pomperaug Valley. The capital stock of the company is $15,000, and the promoters, Judge Warner and E. S. Boyd, are confident that the company will be prepared to install lights early in the autumn of the present year.

Yankton, S. D.—The citizens will soon hold a meeting to discuss the question of lighting.

STREET RAILWAYS.

Anamosa, Ia.—The Chicago, Anamosa & Northern Railway Company will build a new electric line.

Colorado Springs, Col.—The management of the Pike's Peak Cog Road intends to operate the system with electricity in the near future and utilize the natural electrical force that is constantly around the summit of the peak.

Dunkirk, N. Y.—The Buffalo-Dunkirk Electric Company will soon start work on its line.

Escanaba, Mich.—The Escanaba Electric Railway Company is considering the matter of extending its line to Gladstone.

Faribault, Minn.—Donald Grant has plans under way to build an electric car line in this city.

Farmington, Mo.—The St. Francois County Railway Company has absorbed the St. Francois County Electric Railway Company, and will complete the line from Delassus to Flat River via this place.

Ft. Wayne, Ind.—The Ft. Wayne & Wabash Valley Traction Company is making arrangements to establish a line between here and Logansport.

Gulfport, Miss.—Capt. Jones, of the Gulfport & Ship Island Railroad, will build an electric trolley line between here and Biloxi.

Imlay City, Mich.—The proposition is again being discussed here for the extension of the electric car system from Romeo to this place. An effort will be made to secure the $15,000 of stock in the vicinity, which it will be necessary to raise in addition to the right of way and a franchise

Indianapolis, Ind.—Charles H. Henry has asked permission of the county commissioners to build a double-track electric railway along the Churchman Pike.—The Indianapolis & Cincinnati Traction Company is thinking of making extensive improvements here.

Kittanning, Pa.—The Kittanning & Ford City Trolley Railway is to be extended 16 miles from the latter place to Leechburg, where it will connect with the proposed line to Arnold on the Valley road.

Lead, S. D.—A plan for an electric railway between here and the Sundance, Wyo., coal fields, has been projected. It is proposed to build about 40 miles of road passing through Welcome, Wyo., thence to Cyanide. S. D., and this place The promoters are interested in the Economic Power Company, which was mentioned in last week's issue of ELECTRICITY.

Peoria, Ill.—The Illinois Electric Railroad Company, of which U. G. Orendorff, of Canton, is president, proposes to construct an electric line from here to Canton.

Philadelphia, Pa.—The Interstate Street Electric Company, capitalized at $200,000, has been chartered to build a line 20 miles from Port Allegany to Coudersport.

Scranton, Pa.—It is reported here that the Delaware & Hudson Company has decided to equip its line between Carbondale and Wilkes-Barre, a distance of 34 miles, with a third-rail electric system.

Temple, Tex.—Mr. Ahrens, of Reading, Pa., is interested in the proposed trolley line between here and Belton.

Woodbury, N. J.—From recent developments it is believed that the much talked of trolley line from here to Paulsboro will be built this summer.

POWER PLANTS.

Boise, Ida.—The Shoshone Falls Power & Lighting Company will be incorporated with $2,500,000 capital by McDonald & McCoy, of Chicago; Judge Samuel Hughes, of this city, and others. Three plants will be erected, one at Augur Falls, Twin Falls and Shoshone Falls. The plant at the latter place is in course of construction. About 100,000 hp. will be developed by the plants.

Grand Rapids, Mich.—The Cascade Electric Company has been organized, with E. C. Follmer, president. A power plant will be erected on Thornapple River.

Orono, Me.—Preliminary work has commenced at Marshrips on the Penobscot River here for two large concrete dams for a corporation in which William Engel, F. W. Ayers, the Websters and other prominent Bangor lumbermen are interested. It is proposed to utilize this water power formerly used for lumber mills in the generation of electricity for transmission purposes.

Philadelphia, Pa.—Estimates are invited by Dr. Edward Martin, director of the Department of Public Health and Charities, for the erection of a power plant at the new Municipal Hospital on the Macalster farm. Bids will be received until April 11.

San Francisco, Cal.—The Eureka Lighting Company of this city has concluded to begin at once the development of its power water rights on the Trinity River for the purpose of generating electricity for power and light. The rights are sufficient for the production of 6,000 hp., which is at present fully double the amount that can be utilized.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅞@13⅛c.; Lake 12⅞@13⅛c.; casting, 12¾@12⅞c.

Exports of copper aggregated in March over 23,000 tons.

It is reported that the General Electric and Westinghouse Companies will increase the price of lamps 2 cents per lamp.

The New York & New Jersey Telephone Company has declared the regular quarterly dividend of 1½ per cent., payable April 15.

Those best informed on affairs of the Chicago Union Traction Company say dividends on the leased lines will in all likelihood be passed again.

It is claimed by Brooklyn Rapid Transit officials that since last fall the net revenue of the road has increased from 19 cents to 26 cents per car per mile.

The annual meeting of the stockholders of the Nassau Electric Railroad Company will be held in Brooklyn on April 12 to elect nine directors for the ensuing year.

The reorganization committee of the Lake Street Elevated Railroad Company of Chicago has agreed to extend the time for payment of the assessment until April 20.

A conference of the Inter-State Independent Telephone Association has been held in Chicago for the purpose of organizing a telephone supply company with a capital of $1,500,000.

An expert is looking over the property of the Syracuse (N. Y.) Rapid Transit Railway and the Syracuse Lighting Company, which may be sold to a syndicate including J. & W. Seligman & Co., P. A. B. Widener and others.

The Baker City (Ore.) Wonder Electric Railway & Improvement Company has filed a mortgage to secure $5,000,000 six per cent. 15-year bonds, covering a proposed 80-mile railroad from Baker City to Prairie City and 60 mining claims.

The Philadelphia Company has laid claim to the charters for Pittsburg street railway lines secured a month ago by the Verner syndicate. The members of the syndicate regard them as their personal property, and a lawsuit of great importance seems inevitable.

The property of the Lincoln (Neb.) Traction Company must be sold at auction again. Judge Holmes has decided that the company's bid of $1,025,000 for its own property did not comply with the terms of the sale. The other bid for $1,500,000, made by Lincoln and foreign capitalists, was pronounced defective. The sale is for municipal taxes.

The Norfolk, Portsmouth & Newport News Company, capital $9,000,000, of which R. Lancaster Williams is president, and which includes nearly every electric line, heating and lighting concern in southeastern Virginia, is to dissolve. The merger has not paid and the properties will be operated separately.

The New Jersey Short Line Railroad Company, with $3,000,000 capital, has been incorporated to build an electric line from Milltown to Elizabeth, 15½ miles. The new corporation is controlled by the Public Service Corporation and its line is the completing link from New York to Philadelphia.

It is understood that in addition to the new issue of General Electric stock, amounting to $3,325,000, the directors propose to issue the stock remaining unissued in the treasury amounting to $1,062,600, which will make a total issue at this time of $4,387,600. The stockholders will have the right to take a new share for every ten shares of stock now held.

ELECTRIOAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price April 4
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	142
Metropolitan Street Railway	112
Metropolitan Securities	79¼
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	235½
Brooklyn Rapid Transit	43½
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	63
Philadelphia Traction	97¼
Union Traction, $17.50 paid	47
Boston.	
Boston Elevated, full paid	139¼
West End Street, com	92
do. do. do. pref	111
Chicago.	
City Railway	161
North Chicago	87
Union Traction, com	5½
do. do. pref	30½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	23
do. do. pref	56
Electric Lead Reduction	⅞
Electric Vehicle, com	7
do. do. pref	11
Westinghouse, com	159
do. pref	194
General Electric	163
Boston.	
Edison Electric Illuminating	235¼
General Electric	164
Massachusetts Electric Companies, com	19
do. do. do. pref	73½
Westinghouse Electric & Mfg., com	78
do. do. do. pref	89
Chicago.	
Chicago Edison	150
National Carbon, com	30
do. do. pref	100½
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	56
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	126½
Western Telephone Company	8¾
New England Telephone Company	120½
New York.	
American Telegraph & Cable Company	84¾
Commercial Cable Company	191¾
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88⅝
Miscellaneous.	
Chicago Telephone Company	118
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	32
Consolidated Car Heating	64
Standard Underground Cable	200

ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

Chicago Wants Municipal Ownership.

Chicago, Ill., is about to try an experiment. At a recent election its citizens voted by an overwhelming majority to acquire and operate its street railways as municipal enterprises.

Now that the die is cast some of the deeper thinkers of the Windy City have doubts as to the outcome and claim that this radical proposition was carried at the polls because a large body of the voters were ignorant and did not know what it meant.

In this the few wise ones are undoubtedly right. Municipal ownership—not of street railways but of other things—has been tried in Boston and some of our other leading cities with anything but satisfactory results.

As has invariably happened when municipal ownership has been advocated, Glasgow in Scotland is pointed to as the *great example* in this case. But because the thrifty Scot has succeeded it is no sign that municipal ownership in Chicago will prove a success. In fact a few years ago Mr. Robert Crawford of Glasgow, a strong advocate of municipal ownership in that city, visited Chicago and in that very locality made the following remarks:

"Before I came to this country I saw no reason why American cities should not adopt municipal ownership of waterworks, traction lines and other large semi-public concerns, and wondered why they had not done so. But now that I have obtained an insight into the conditions that prevail in your cities I have entirely changed my views. As things are now in your cities municipal ownership is an impossibility. Success in that great undertaking is out of the question so long as party politics figures in municipal elections, and so long as city offices are used to reward political work. This is no derogation of the principle of municipal ownership, for that has been tried with amazing success in Glasgow. There, however, the city government has long been conducted solely for the good of the city, and I do not hesitate to make the statement that during a long term of years no public servant in Glasgow has derived directly or indirectly a single penny of profit improperly from the conduct of the city's affairs. Nor has any place under the city government been given to reward a friend of any official.

"With the conditions that exist in American cities to-day, municipal ownership is utterly impracticable. It can never be a success until the system of political rewards is entirely divorced from city government—a condition of affairs which is not claimed to exist, so far as I can learn, in any large American city at the present time. Unless the municipal government is conducted with an eye single to the welfare of the city, and unless the city officials are prompted by the same unselfish patriotism that impels a man to volunteer in time of war, municipal ownership is bound to be a disastrous failure."

This may not prove agreeable reading to city officials in general, but it indicates that the Scottish gentleman from Glasgow had a very fair insight into the methods of "playing politics" in vogue in many of our cities.

The reason given for the advocacy of municipal ownership of street railways in Chicago is that the service afforded by the local companies was poor. This may very probably be the case, but it would seem as though suitable measures might have been taken by the city officials to force the railway companies to better their service without having to have recourse to municipal ownership.

Apparently the only redeeming feature

of the whole proceeding, so far as Chicago is concerned, is the fact that the will of the people cannot be carried out until the debt incurring privileges of the city are enlarged by the Illinois Legislature.

* * *

The Incandescent Lamp Situation. In the future there will be no more shaving of prices on incandescent lamps, if the General Electric Company has its way.

At a recent meeting in this city of incandescent lamp manufacturers the Edison Electric Light Company and the General Electric Company agreed to discontinue some thirty infringement suits which had been instituted against various manufacturers, dealers and consumers, and the majority of the incandescent lamp manufacturers in the country agreed on their part to pay to the Edison Electric Light Company and the General Electric Company a royalty on every lamp sold. The two companies owning the patents style themselves the licensors, while the other companies, of which there are about twenty-six, are known as the licensees, and the whole arrangement is not a combination or trust—so the parties interested state—but is a friendly working agreement to prevent expensive litigation and the cutting of prices on lamps.

Several lamp concerns are not parties to the arrangement, among others, that of the Sawyer-Man Electric Company.

The licensors and licensees have fixed the price of lamps to be sold to dealers and consumers, and there is to be no cutting of the prices. On the other hand, it is stated that the price of lamps will not be raised. Let us hope that this will prove to be the case, but where a number of companies have matters entirely in their own hands, as have the licensors and licensees in this lamp question, it is a temptation sooner or later to boost the price up a cent or two. A cent or two a lamp does not at first sight seem much, but where some 45,000,000 lamps a year are consumed, as at present in this country, two cents a lamp means $900,000 a year. This would prove a nice extra dividend, and is a temptation that will require considerable will power to resist.

* * *

Production of Mica in 1902. In view of the fact that mica is so extensively used in the manufacture of electrical apparatus at the present day, a report on the production of this mineral in 1902 by Dr. Joseph A. Holmes for the United States Geological Survey should prove interesting.

The total quantity of mica produced in the United States during the year 1902, was as follows: Plate mica, 373,266 pounds, valued at $83,843; scrap mica, 1,028 short tons, valued at $13,081; and mica-rough as mined, or unmanufactured, 372 short tons, valued at $21,925; making a total value of $118,849.

The increase in the production of plate mica during the last three years is due to the increasing quantity of small-sized mica disks and rectangular sheets that have been cut for electrical purposes. Some of the small clear pieces obtained in cutting up the large sheets are now split very thin, rearranged, and cemented closely together, forming large sheets called micanite, which are then cut into the shapes and sizes desired. For some purposes these sheets of micanite answer as well as the natural sheets and have the advantage of being much cheaper. In recent years, scrap mica has been manufactured into a covering for boiler tubes and steam pipes to take the place of the more expensive asbestos coverings. Waste mica not available for other purposes is used in the manufacture of wall papers and lubricants. During 1902, there was, however, a large falling off in the production of scrap mica, which in 1902 amounted to 1,150 short tons, valued at $14,606, as against 2,171 short tons, valued at $19,719 in 1901.

The tables which show the great increase in the importation of mica during 1902 are significant. This increase valued at $131,278, is larger than the total value of the product of mica in the United States during 1902. It illustrates the increasing demand for mica in this country, but also suggests the sad fact that mica can be mined in India and landed in this country at a lower price than it can be mined in some places in the United States. Canada is also a large contributor to our mica supply.

Although mica is widely distributed in the United States, actual mining has been limited during the last few years to North Carolina, New Hampshire, South Dakota, New Mexico, Idaho, Virginia, and Colorado. Some development work has also been carried on in California, Nevada, Maine, Alabama, and Georgia. In several of these States good deposits of mica are known to exist that are not now available on account of their distance from railroads or other means of transportation.

We would call the attention of electrical manufacturers and engineers to the "Proposals Invited" to be found on page 207 of this issue.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The Iowa Electrical Association, which was called to hold its annual meeting in Des Moines April 13 and 14, has postponed the gathering for one week, April 20 and 21, according to announcements sent out by Secretary W. S. Porter, of Eldora. The headquarters of the meeting will be at the Savery.

Dr. Charles Baskerville, professor of chemistry and director of the laboratory in the University of North Carolina, announced Friday night before the Chemists' Club in this city his discovery that thorium, hitherto known as one of the 70 primary elements, is complex in its nature. Dr. Baskerville has resolved thorium into two new elements. He has named one of these carolinium, after the State; the other berzelium, in honor of the great Swedish chemist who nearly a hundred years ago discovered thorium. It has never before been the good fortune of an American chemist to discover a chemical element. Dr. Baskerville's discovery of two elements is the result of ten years of persistent labor.

At a meeting of the executive committee of the International Association of Municipal Electricians, held at Brooklyn, N. Y., April 2, the following papers were selected and assigned to be read at the ninth annual convention to be held at St. Louis, September 13-14: "Street Lighting, Principles Involved and Systems Used," A. S. Hatch, Detroit, Mich.; "The Limitations of the Telephone for Fire Alarm Purposes," Adam Bosch, Newark, N. J.; "The Inspection of Theaters from an Electrical Standpoint," William H. Thompson, Richmond, Va., "Methods of Testing," Walter M. Petty, Rutherford, N. J.

The Crocker-Wheeler Company of Ampere, N. J., has arranged to insure the lives of all of its workingmen for the benefit of the men's families. The plan is practically complete, and its prime object is to further the interests of the men employed. It is planned that the Crocker-Wheeler Company, will assume the expense of the insurance and create a reserve fund to cover losses. Families of the workmen will be the beneficiaries, and the plan will be probably that known as straight life insurance. It has been suggested that a form of endowment insurance be established, and that idea is being held under advisement.

THE LIVERPOOL-SOUTHPORT ELECTRIC RAILWAY.

(From our London Correspondent.)

(Concluded from page 187)

The sub-station equipment, save as regards amount of plant, is identical, and to describe one in detail will give an adequate idea of the whole of them. The three largest, Seaforth, Sand Hills and Formby, have each four rotary converters, whilst Birkdale has three, provision being made in each case for extensions. Each rotary converter is arranged with its corresponding groups of statics alongside, the high tension oil switches being placed underground.

The rotary converters are in appearance similar, in general design, to the standard direct current machines. They are 8-pole developing 600 kw. at 600 to 650 volts at 375 revolutions per minute. The core disks are segmental and dovetailed into machined grooves on a cast-iron spider, the rim of which following standard practice is sectional to avoid shrinkage strains.

On the alternating current side of the machine are six gun-metal slip rings, which tap the armature windings at equidistant points, connection between the radials and the outer rings being effected by insulated bolts carried through the intervening rings.

Each slip ring carries three laminated copper brushes.

On the direct current side carbon brushes are used, which slide in radial brackets under the pressure of compensating spring levers. The average finished weights of this rotary are armatures 10,380 lbs, magnets 21,100 lbs., complete machines 40,940 lbs.

The transformers are of the air-blast type, and have each a capacity of 200 kw.

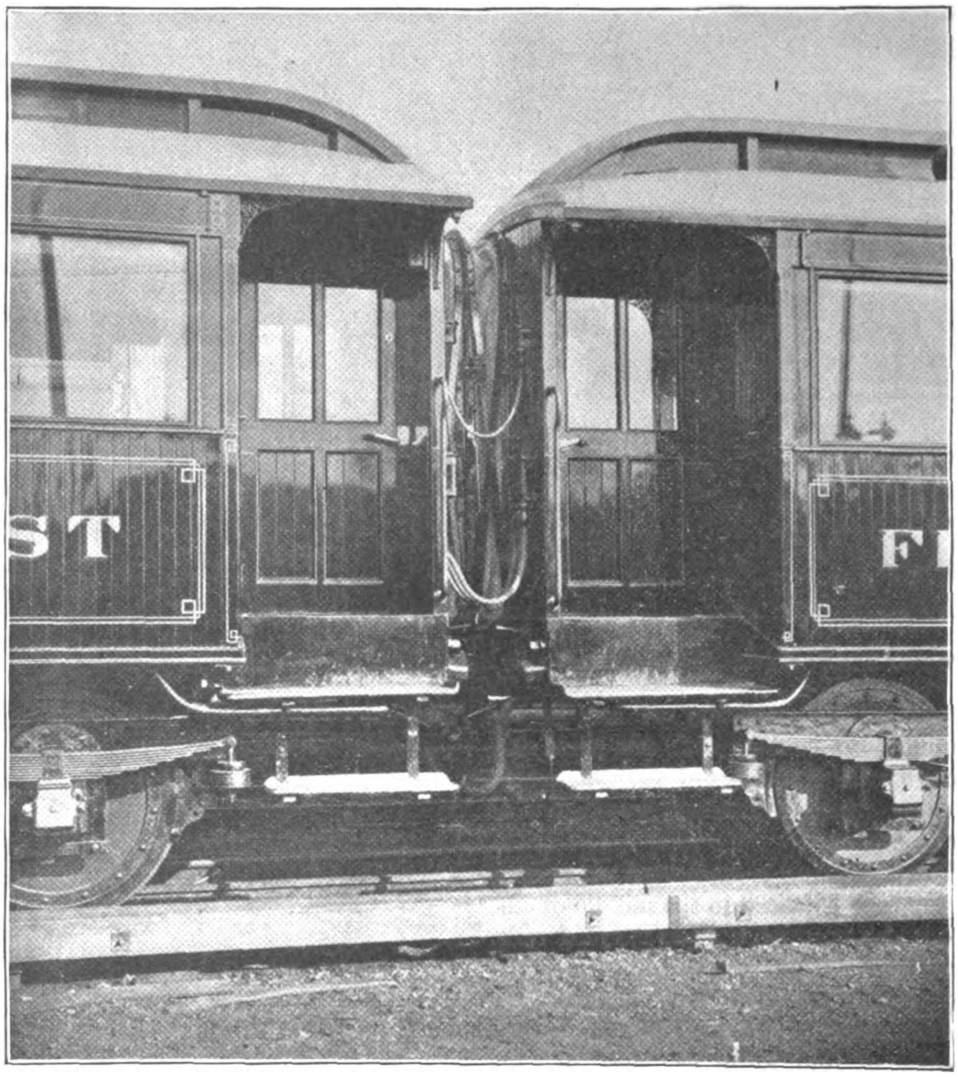
The blowers, of which there are two in each sub-station, consist of a standard Dick, Kerr 5 hp. motor, coupled on a combined base to a Davidson Sirocco fan, which is keyed direct on the motor shaft. The capacity of each fan is 8,000 cubic feet of air per minute, at a pressure of 2 inches to 3 inches of water.

The sub-station switchboads consist of a high tension and low tension side, the latter having been supplied by Elliott Bros., the switches and circuit-breakers being of the standard Dick, Kerr pattern.

The high tension cables leading from the power house are arranged in each case in triplicate. Under ordinary working conditions all three cables are used, but in case of breakdown of any one of the cables, the two remaining ones can do the work without the drop or current density exceeding the permissible limit. The cables were made by W. T. Glover & Co. The extra high tension cables are of the triple triangular type, diatrine paper insulated, lead covered and armored, laid on the solid system.

Turning now to the permanent way, two additional rails have been laid. One of these is brought alongside each track on insulators, while the other is placed between the running rails, uninsulated on shoe is provided on the train for this fourth rail, the current being delivered through the wheels to the running rails, and thence through the cross-bonds to the fourth rail. The third and fourth rails are both of equal section, mild steel, 70 lbs. per yard, and laid in 60 foot lengths.

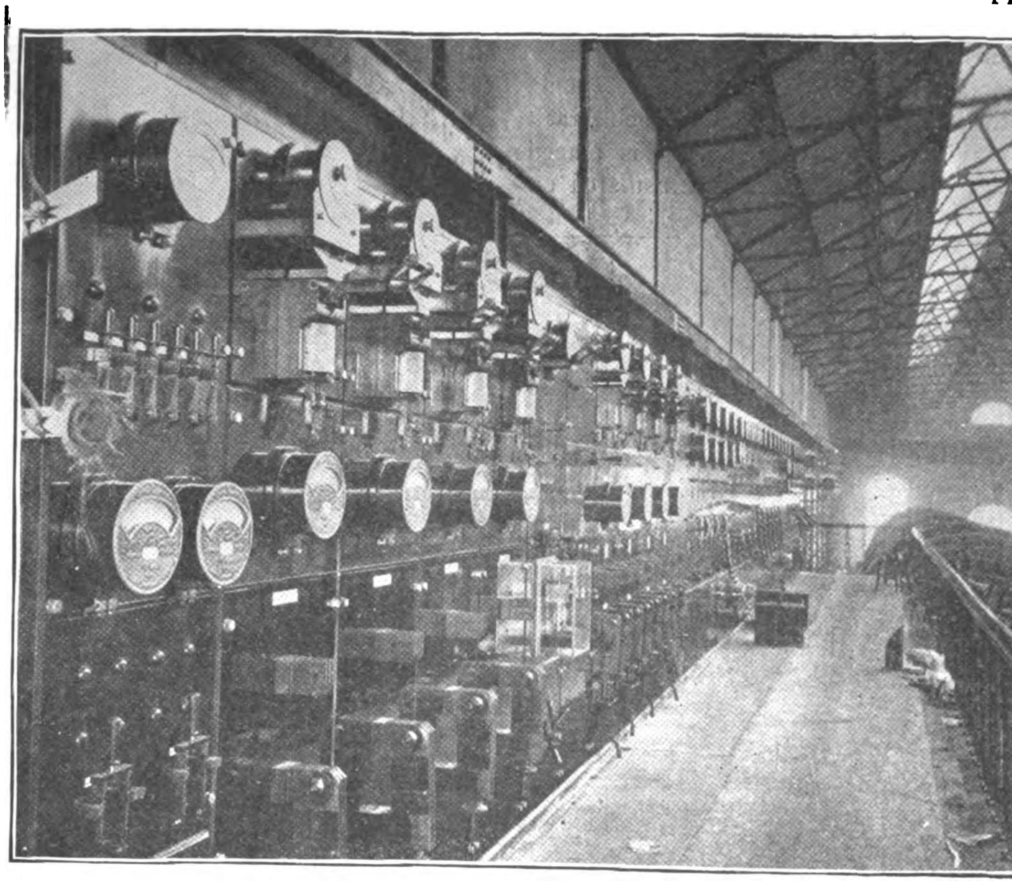
The third rail is supported at intervals of about 10 feet on insulators of reconstructed granite, held in position by two



Cars Coupled on the Liverpool-Southport Electric Railway.

the sleepers, this forming the principal part of the return circuit, while the joints of both the third and fourth rails are bonded in the ordinary way; the fourth rail is also cross bonded to the running rails, the ends of each running rail being connected by such a bond to the fourth rail. While by this arrangement the troublesome bonding of the running rails is avoided, as also the complications involved by using an insulated fourth rail for the return, the further advantage is obtained that the running rails participate to a marked degree in conducting the return current, thus increasing the conductivity of the return circuit, with consequent reduction of drop. No collector clips, the center of the rail being exactly 3 feet 11½ inches from the center line of the track, and the top of the rail 3 inches above the surface of the track rails. This dimension being that agreed upon by all the main line railway companies in order to obtain uniformity, in case of extensions of third rail system. It is of ample section to convey the full amount of current required by the trains, when between two sub-stations, without causing any appreciable loss in voltage. Generally the third rail is placed in the 6-foot way between the tracks, but occasionally it is brought outside the track, to suit special conditions. At all level crossings gaps in this rail have been provided of such a

length that there can be no risk whatever to the public; where these gaps occur the third rails are bonded with cable underground. Timber guarding has been provided at all the busy places on the line,



Power Station Switchboard on the Liverpool-Southport Electric Railway.

to prevent the possibility of any person coming into contact with the third rail, though even if they did so, the consequences, while unpleasant, would not be serious.

The fourth rail is supported on wooden blocks, and is placed in the middle of the 4-foot way between the two running rails.

At most stations the third rail is interrupted and the ends are connected by cables to section switches. This apparatus consists of four knife switches, one for each end of the up and down line, which, in the ordinary way of working, are connected in parallel. By cutting out one of these switches in two adjacent boxes, any part of the up or down line may be made currentless.

In providing for expansion and contraction, due to change of temperatures in the rails, they are divided into sections of 300 feet, and the joints between the rails making up this section are known as "fixed joints." The joints connecting the sections themselves are known as "expansion joints." At the fixed joints no provision is made for expansion or contraction, this being concentrated at the expansion joints. The fish plates at the fixed joints are made as rigid as possible, and the bonds are four in number, two bonds being fixed in the web of the rail, and two bonds in the flange of the rail.

It was deemed advisable to use bonds of semi-flexible type, which have a conductor built up of parallel strands of copper ribbon or "flat wire" with solid copper terminals. They are thus sufficiently flexible to provide for any movement which may take place at the joints, and are more easily adjusted in case of any variation in distance between the bond holes at the time of construction. The bonds at the expansion joints are four in number of the same cross section as those at the fixed joints, but all four are fixed in the flange of the rail. These bonds are also made of "flat wire."

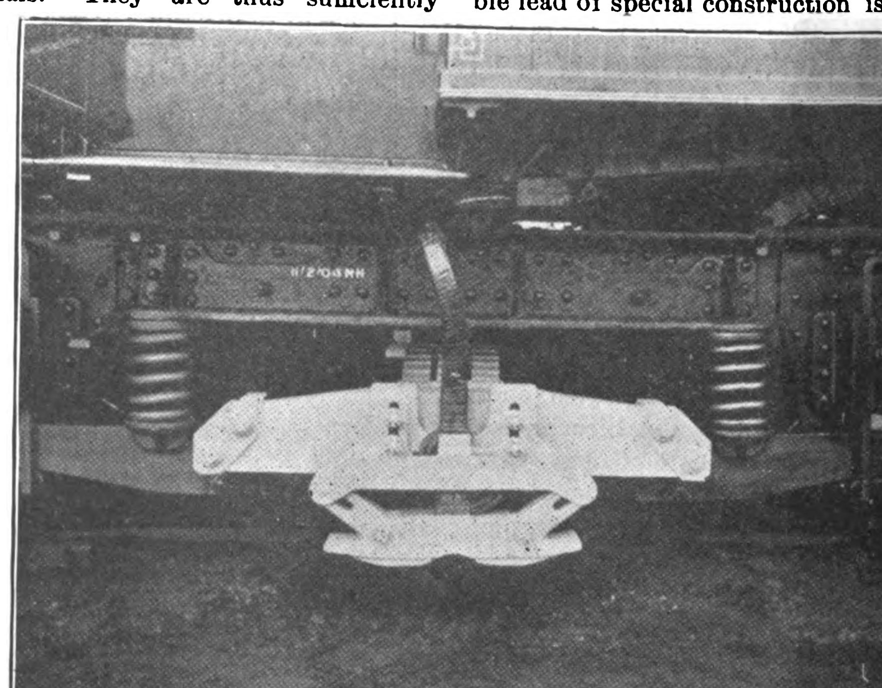
The fish plates at the expansion joints are of special design, and properly slotted to provide for any change of length which may take place in the 300 feet section. This system of bonding is carried out on both the third and fourth rails. The terminals of all the bonds are of solid copper and are expanded in the bond holes by means of screw or hydraulic compressors.

Each track rail is bonded to the fourth or negative rail by means of flexible cable bonds. The bonds were supplied by the Forest City Electric Company.

The trains consist of two first and two third-class cars as a rule. The thirds are at either end and are equipped with two motor bogies, each bogie carrying two Dick, Kerr 150 hp. motors, there being eight motors per train. A cast-steel slipper attached to a beam on each side of the motor bogie, rubs on the third rail.

The motor bogies are built entirely of steel and have 8 feet wheel base. The wheels are an exceptional size in electric traction, being 3 feet 6 inches.

The slippers weigh about 90 lbs. each. On straight runs there are four shoes collecting at one time. From these slippers, which are suspended by forged slotted links from a wooden beam carried on extensions on the bogie, a highly flexible lead of special construction is carried



Brake on the Liverpool-Southport Electric Railway.

to a fixed terminal from which the main cables pass to the controller.

A large motor car horn containing a reversed reed of special construction is used in place of a whistle, a connection to the vacuum reservoirs enabling the air

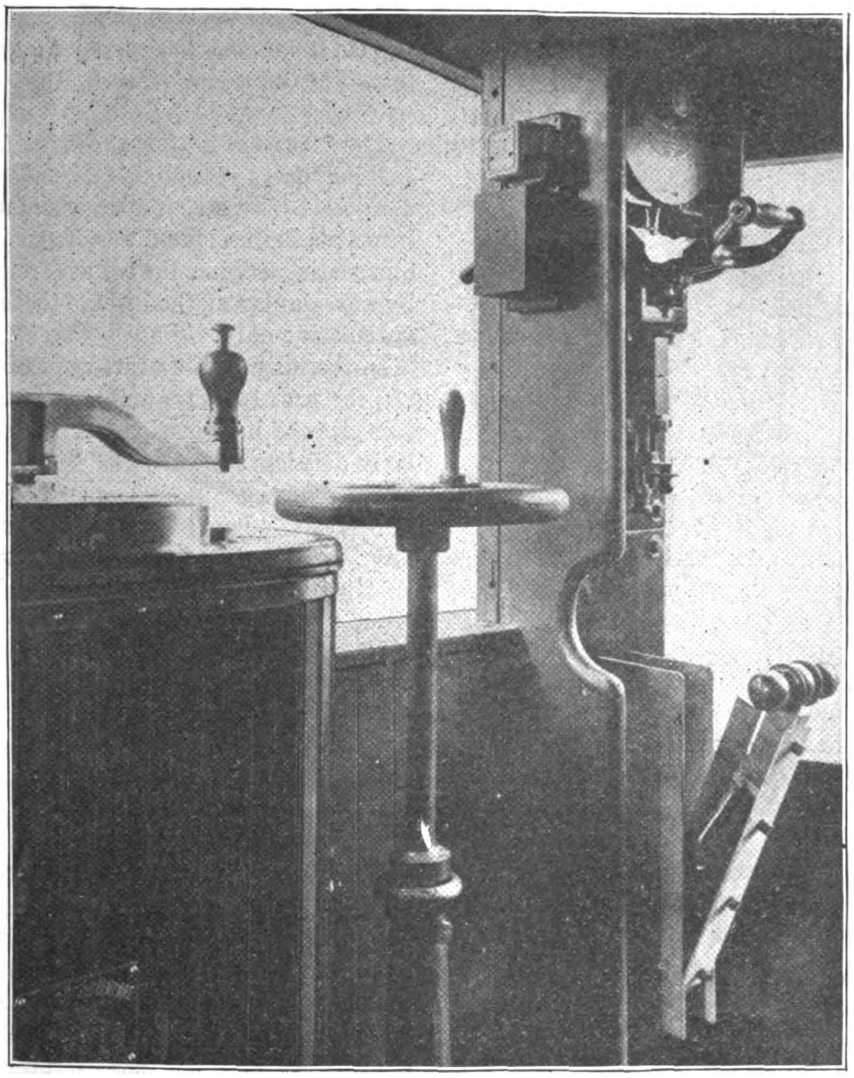
for blowing it to be supplied from the atmosphere.

The motorman's compartment, in addition to the controller and switches for the main motors, contains a motorman's brake valve, a vacuum gauge, a single pole switch for starting the brake motors and fuses for the pump motor and brake control circuits.

The motor compartments have, with the exception of the roof, which is covered with sheet steel plates, been lined with uralite, a fireproof material, the floor also being fireproof. In addition to the cable troughs, in which the cables are placed for conveying current to the motors and equipment, being lined with uralite, the whole of the floor over the motors is covered with the same material and thin steel plates. All the trains carry fire appliances, and ample steps have been taken to insure safety in this respect.

The motors are of the Dick, Kerr 4 A railway type and they drive on to the axles through single reduction gear. They are rated to develop 150 hp. at an armature speed of 470 revolutions. The complete motor weighs 6,050 lbs.

One of the most interesting features of the equipment is the method of control, which is known as the direct multiple control system, in contradistinction to the multiple unit, the main difference in the systems being that in the case of the former it is possible to control the whole equipment of the train by means of two main cables. Previously, the great difficulty in the way of such a simple arrangement lay in the construction of the controller, it being practically impossible to carry the whole of the current through one controller. In the Dick, Kerr system this is rendered possible by the use on the controller of the metallic shield blow-out, which is part of the standard design of their tramway and railway controllers. They contain two power cylinders, each controlling one-half of the train, that is, one motor car is actuated from one cylinder and the rear motor car controlled from the other. Without, therefore, interfering in any degree with the completeness of the train, it would be possible to divide one of the present trains into two distinct units. In other words, the system is claimed to embrace the whole of the advantages of the multiple unit control without the necessity of employing numerous connections involved by a contractor system.



Interior of Cab (right side) on the Liverpool-Southport Electric Railway.

The train is entirely operated by the motorman in his cab at the front.

In the cab is a Dick, Kerr D. M. 4 controller capable, in conjunction with eight reversers, which are bolted up adjacent to their various motors under the floor, of operating the eight motors on the pair of motor cars.

The two power cylinders of the controller are geared together and operated from a crank handle, each cylinder barrel being flanked by a powerful metallic shield blow-out solenoid. These may be swung open on hinge pins, such action automatically cutting the winding out of circuit, or, if necessary, lifted off and removed for inspecting the cylinders and contact fingers.

There is also provided two sets of a single-pole quick-break knife switches, and metallic shield blow-out circuit breakers, each of these designed for an overload with a calibration of 500 to 1,600 amperes.

The reversal of direction of the motors is effected by means of a special apparatus operated by the controller reversing barrel. This reversing apparatus carries contacts which are normally left open by gravity, but can be closed by an electromagnet, which becomes operative through the agency of the controller reversing barrel. There are eight reversers per train, one per motor, which are arranged in four parallels of two in series across the system. In series with each reverser pair are the contacts of two magnetic overload releases, the coils of which are each in the main circuit of one of the motors, its reverser contacts and solenoids. Consequently, whether a pair of motors be in series or in parallel, the overload current in either one will cause both releases to open and cut out the pair. These releases are inclosed in small neat cast-iron boxes mounted on the sides of the car near the truck facing outwards. When open, a flap falls down exhibiting "open" in raised white letters on a scarlet ground, which catches the eye immediately. The releases may also be tripped by hand to cut out any pair of motors that may become disabled.

Powerful and certain action of the reversers is secured by a compact magnetic circuit and a free and balanced suspension of a heavy clapper, while uniform and reliable contact is insured by the use of several independent spring contacts, so hung as to render sticking impossible.

In circuit with each pair of reversers is

a cartridge fuse and hand knock-out switch in the cab. The latter is for opening the relay circuits of the reversers, in order to cut off the motors should the controller cylinders stick in any way, or an accident be imminent.

In accordance with the usual practice, the power cylinder is locked when the reversing is in an "off" position, and only then can the handle be removed, while the reversing is locked when on "reversed" or "ahead" and the power on one of the notches.

The power couplings between two cars simply consist of stationary male plug contacts in insulating tubes screwed to the ends of the coaches, with dummies facing them on the coaches opposite, into which female plugs, buried in insulating handles at the end of long flexible leads, click home, according to whether connection or disconnection is required.

The heat, light and reverser couplings are mechanically in one and similar in arrangement to the power.

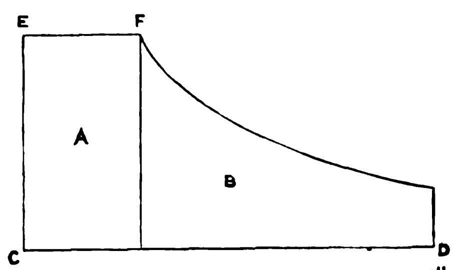
They are all mounted about half-way up the car wall comfortably in reach from the platform, thus obviating all risk of getting on the track and shocks from the third rail.

INDICATOR DIAGRAMS FROM STEAM TURBINES.*

BY W. H. BOOTH.

It is so often stated that the steam turbine cannot be indicated that there is a tendency to accept such statement as true. It is by no means true, but has been made by those whose ideas of indication are drawn from the instrument employed by the reciprocating engine. The steam turbine can be "indicated" with a very considerable degree of precision, and though the writer in not prepared to suggest at the moment an autographic recorder of the "indication," there is very little doubt that such a record could be contrived. An indicator diagram, as usually obtained from the reciprocating steam engine, is a record of the steam pressure at every point of the piston stroke. It is employed as a means of finding the power exerted on the piston. It does not directly tell us the power exerted by the working steam. The power exerted in a steam engine is made up of two parts. First, during the admission of the steam into the cylinder, the heat of the fire under the boiler is directly converted into work, a certain portion of the steam being pushed into the cylinder by the direct action of fire causing evaporation in the boiler. If the steam pipes are small, the full boiler pressure may not be carried through to the cylinder, and during the steam admission period the steam which is pushed out of the boiler by the direct furnace heat may act partially by expansion, and do some work during admission. Admitting a level admission line, however, the initial steam does no work by expansion. When the admission valve closes, the inclosed steam expands behind the piston, and does work. In the diagram, Fig. 1, the two portions of work are shown by the areas A and B. A is the work done directly by the furnace, and B represents that done by the expanding steam. The line C D is the line of absolute vacuum. The gross work done is represented by the area D C E F. On the opposite side of the piston, however, there is work done by the atmosphere, or by

Fig. 1.



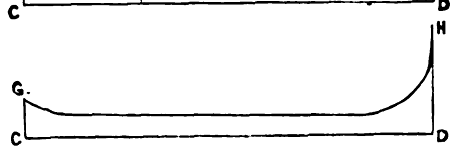


Fig. 2.

the steam in the exhaust pipes and condenser, and this is shown by the diagram Fig. 2, the work done being represented by the area D C G H. The actual indicator diagram as secured from an indicator does not show the two diagrams which represent one stroke upon the same card, but shows the condition of things on one face of the piston only during two strokes. The actual so-called indicated power of an engine is the difference between the gross forward pressure of all the cards for Fig. 1, and the gross backward work of all the cards for Fig. 2. The best of two engines may be made to appear the worst if care be not taken to keep to a minimum all the Fig. 2 cards.

Such cards as this cannot be gotten from the steam turbine, but, nevertheless, the pressure in the turbine can be gotten at any part of the length, and from this something can be learned of the behavior of steam in the turbine, and particularly of the effects of superheated steam. Where saturated steam is employed in the turbine, its temperature at any point can be ascertained by means of a mercury pocket of thin brass let into the body of the outer casing. A series of these pockets fitted along the length of the turbine, and fitted with thermometers, will give a series of temperature readings at such points which can be plotted as a curve of pressures by aid of a steam table, or the thermometers may be graduated in pounds to avoid translation. A series of pressure gauges may also be used, and will correspond with the thermometer readings at the same section. The rate of expansion can be found in this manner as an aid in fixing upon the dimensions and proportions of the several parts. Where superheated steam is employed the difference of the readings of the pressure gauges and of the thermometers will show the extent to which the superheat is retained as the steam travels through the turbine.

The constancy of the conditions in a turbine on a steady load renders such methods of investigation easy and reliable, in which the turbine differs from the reciprocating engine, the results from which by any similar method would be at least speculative only.

In the flood of literature appearing during the past 10 years on steam turbines, this class of information has been singularly deficient.

Tests giving steam consumption per kilowatt hour may induce purchasers to buy turbines, but they are comparatively as valueless as the photographs of high-speed boats for any information they afford on the principles underlying the turbine, and the action in it of the working fluid.

The B.H.P. for a turbine is so easily gotten that the I.H.P. as obtained from the reciprocating engine may be dispensed with. The chief value of an ordinary indicator diagram is to show the action of the steam in the cylinder, and it is the action of the steam, especially in the long variety of the turbine, that is now of more serious interest. As already surmised, the effect of superheat is probably obtained at an earlier temperature than is necessary in reciprocating engines, but better assurance of this would be gained by a series of positive records of temperatures and pressures taken in the course of the length of a turbine. There are many who think that turbines have grown too long, and that the larger ends are mere churns; that the claims for extended expansion are somewhat overdrawn and that more modest dimensions would serve. Such questions would be better answered were information forthcoming in the direction indicated. With the growing number of makers it is hardly likely longer be to neglected.

*From the "Electrical Review," London.

If already obtained and not published, it may account to some extent for the slow progress made by this most interesting of steam motors.

ELECTRICAL STATION PRACTICE.

ARTICLE XXXII.

BY W. H. RADCLIFFE.

The amount of electrical power provided by a generator, its percentage of efficiency, and the values of the various losses occurring in its operation are matters that must be determined from time to time in the management of an electrical station. The determination of these values in the ordinary case of a direct current generator will be considered in the present article.

The power which is furnished by a generator for use in the main circuit is that generally implied when the term "electrical power" or "output" is mentioned. This quantity is measured in watts or in kilowatts according to its size; if the output is less than 1,000 watts it is expressed in watts, otherwise it is expressed in kilowatts, 1 kilowatt being equal to 1,000 watts, and 1 watt being equal to 1 volt multiplied by 1 ampere. In order therefore to obtain the value of the output of a generator it is merely necessary to measure its pressure on a voltmeter, its corresponding current in the main circuit on an ammeter, and multiply together the values thus found. The total electrical power developed by a generator is some value greater than this, being in addition to that supplied to the main external circuit, the power used in the armature and field windings. The value of the total electrical power does not, however, enter into the output of the generator, as this term is commonly interpreted, but in the design and construction of a machine it must necessarily be considered.

The efficiency of a generator in its commercial sense is the ratio of the electrical power supplied by a generator for use in the main circuit to the mechanical power which must necessarily be used to produce it; in other words, it is the output of the generator divided by the input of the generator, both these quantities being expressed in the same terms. The commercial efficiency is expressed as a percentage of 100, 100 per cent. representing the efficiency of an ideal generator converting the entire mechanical power applied to its shaft into useful electrical power in the main circuit. In practice only about 90 per cent. of the mechanical power is converted into useful electrical power, the remaining 10 per cent. being used in overcoming the losses, which will later be considered.

There is in addition to commercial efficiency another term, "electrical efficiency," which must not be confounded with it. The electrical efficiency is the ratio of the electrical power supplied to the main external circuit to the total electrical power developed in the generator; obviously, its value is governed entirely by the internal resistance of the machine, that is, the resistances of the armature and field windings. In modern generators the internal resistance is generally such as to cause a loss of about 4 per cent.; the average electrical efficiency of a generator is therefore approximately 96 per cent. As both the total electrical power and the electrical efficiency of a generator are matters that can be calculated directly from the losses, that will later be discussed, we will turn our attention now to the testing of a generator for obtaining its commercial efficiency.

The commercial efficiency of a machine is usually taken at different loads so that an efficiency curve may be drawn. To illustrate the method employed, however, it will merely be necessary to find its value at one point, and for this purpose let the full load point be selected. The problem then resolves itself into finding the mechanical input at full load, and the electrical output at full load. In order to determine the former of these values it will generally be found advisable to run the generator as a motor at its rated speed, and to load it by means of a Prony brake. The generator must be stripped of all belting or other mechanical connections, supplied with its normal voltage and full load current, and the pressure of the Prony brake upon its armature shaft or pulley adjusted until the rated speed of the armature is obtained. The number of foot-pounds developed by the armature and measured on the Prony brake under these conditions should be substituted for T in the formula

$$P = \frac{T\,(2 \times 3.1416 \times S).}{33{,}000}$$

In this formula P represents the number of horse power that must be applied to the machine in order to cause it to develop its rated full load at normal speed, T denotes the value in foot-pounds determined by the Prony brake, and S represents the speed of the armature in revolutions per minute. The substitution of these respective values in the formula just given, and the solving of the right-hand side of the equation will give the value in horse power of the mechanical input at full load. The electrical output in horse power at full load is easily calculated by multiplying the normal voltage by the full load current and dividing by 746. Now, since we have both the input and the output at full load expressed in horse power, dividing the former value by the latter will give the percentage of commercial efficiency of the generator at full load.

A simpler method of obtaining the commercial efficiency of a generator, if there be available an electric motor for which there has been drawn a calibration curve giving the various horse powers developed when this motor is supplied with a given number of volts and amperes, consists in running the generator with this motor and measuring the number of watts generated for the corresponding power applied. By simply converting these two quantities into the same units, and dividing the former by the latter, will give the percentage of efficiency of the generator.

Having ascertained the commercial efficiency, or briefly the efficiency of the generator, by either of the methods previously described, the difference between the ideal 100 per cent. and the efficiency found will be due to certain losses in the generator about to be discussed. These losses may be classified as mechanical losses and electrical losses; of the former are the friction of the belt, the friction of the brushes, and the resistance or friction of the air; of the latter are the eddy current loss, the hysteresis loss, the armature resistance loss, and the field resistance loss. The usual methods employed for determining these various losses in the order named will now be taken up.

First of all, the generator to be thus tested should be belted to a calibrated motor which latter machine should preferably be of the constant potential, shunt wound type. By the term "calibrated motor" is meant one for which a calibration curve has been drawn, as described in the second preceding paragraph. The friction of the bearings and belt of the generator are determined together by raising the brushes off its commutator and running it at the rated speed by means of the calibrated motor. The amount of power as ascertained from the calibration curve of the motor for the voltage and current used therein when driving the generator, as just explained, is a measure of these two losses. The power thus used is practically constant at all loads and is about 2 per cent. of that necessary to drive the generator at full load. The friction of the brushes can very conveniently be determined next by simply

lowering them on the commutator and giving them the proper tension. The increase of power resulting from the greater current that will now be taken by the motor to run the generator at the rated speed, will be a measure of this loss. In general, its value will be about .5 per cent of the total power required to drive the generator at full load, and this also will remain constant at all loads. The friction of the air upon the moving armature of the generator cannot be determined experimentally, but theoretically this loss is small and may be estimated as .5 per cent.; it is also constant at all loads.

Coming now to the electrical losses, the eddy current loss and the hysteresis loss are next in order. In practice, these two losses are generally combined and called the core loss of the generator. As such, it may be determined experimentally by exciting the field magnets of the generator with the normal full load field current through the magnet coils, and noting the increase of power required by the motor to maintain the rated speed of the generator thus excited under no load. The value of the core loss is approximately 3 per cent. of the power required to operate the generator at full load, and it is constant at varying loads. If it be desired to divide the core loss into its component parts, it is necessary to also run the generator under the same conditions as before but at half its rated speed. If, then,

h = the power lost in hysteresis at rated speed,

e = the power lost in eddy currents at rated speed,

t = the power lost in hysteresis and eddy currents at rated speed,

s = the power lost in hysteresis and eddy currents at half speed,

there may be formed the two following equations:

$$t = h + e, \text{ and } s = \frac{h}{2} + \frac{e}{2},$$

from which the elimination of h will give $e = 2t - 4s$. By referring to the notation previously given the letters in the last equation, the interpretation thereof is that the power lost in eddy currents at rated speed is equal to twice the power lost in hysteresis and eddy currents (core loss) at rated speed minus four times the power lost in hysteresis and eddy currents at half speed. The value of the eddy current loss thus found will be about 1.5 per cent. and constant at all loads.

Having previously ascertained the power lost in both eddy currents and hysteresis, and knowing now the power lost in eddy currents alone, it is easy to find that lost in hysteresis by simply subtracting the latter known value from the former. The value of the hysteresis loss is therefore approximately 1.5 per cent., and it is constant at different loads.

There yet remains to be determined the armature resistance loss and the field resistance loss, but as for the calibrated motor this may be disconnected from the generator as it need not be used further in the test. The armature resistance loss necessitates that the resistance of the armature winding between the commutator bars upon which press the positive and negative brushes, be measured. The method of measuring this resistance will be described in the next article, wherein will also be taken up other measurements that are at times required in electrical station practice. Let us assume, therefore, for the present, that the value of the armature resistance be known. This value, which we will call R ohms, together with that of the full load armature current, which is also known and which we will call C amperes, are sufficient data for calculating the armature resistance loss at full load. It is evident that to force the full load current C through the armature resistance R will require a pressure of CR volts, and that the watts lost in doing so will be the voltage multiplied by the current or $CR \times C = C^2R$ watts. Expressed in horse power, this loss will be $\frac{C^2R}{746}$, and at full load it usually will be about 2 per cent. of the total power required to drive the generator fully loaded. The armature resistance loss varies in proportion to the load, in fact, as the last expression shows, it increases as the square of the armature current.

The field resistance loss is calculated in precisely the same manner as just explained for the armature resistance loss, it being equal in horse power to the square of the full load field current multiplied by the resistance of the field winding and divided by 746. In a shunt generator it is practically constant at 2 per cent. of the total power applied at full load, but in a series or in a compound generator it will vary in proportion to the load.

The electric system that was recently installed in the Lehigh Valley Coal Company's Centralia, Pa., colliery has proven so satisfactory that the question of installing it at other collieries is now being considered, and it is also proposed to make it the motive power for pumping machinery, a new innovation recently introduced with success at the Enterprise colliery.

STANDARD PRACTICE IN THE USE OF ALTERNATING CURRENT ELECTRICAL APPARATUS.*

BY J. J. GIBSON.

(*Concluded from page 192.*)

Were the speed of the engines practically constant at all loads, the distribution between the loads of the engines would be indeterminate. Where the speed characteristics are identical the load is evenly divided if we have units of same size and equal armature reactions.

Were the speed characteristics not straight lines and were they to fall off more rapidly at the higher loads than at the lighter loads, then there would be more even distribution at the higher loads than at the lighter for the reason that the horizontal distance between the speed characteristics is less the more rapidly the curves fall off to the horizontal.

Engine manufacturers thoroughly appreciate this situation. They recognize all of these requirements, and they are meeting them.

The steam turbine affords absolutely uniform angular velocity. The water wheel does also. In the case of the water when the momentum of the column of water has a similar effect to that of a flywheel and may cause the water wheel governor to continue to act after the time when it should stop acting.

While the problem of properly driving alternators in parallel is a mechanical problem, still, there are conditions in an electrical circuit which give rise to chances of hunting or surging of the load. If a load on a system is entirely uniform, or what you may call a dead load, then such chances are not present. If, however, the generators are serving a load made of synchronous motors or rotary converters, which we might call a synchronous load, the load is a pulsating one and we have a condition where a prime mover delivering its power by impulses is feeding a pulsating load. There is a reaction back on the generator from the load because the power is taken intermittently and this reaction may cause the generator to vary in its angular position. This action is prevented by placing what are known as dampers on field poles of synchronous motors, rotary converters and on the generators themselves. These dampers consist of copper grids set into pole faces, which are in reality nothing but paths of low resistance in which currents flow, which are induced by any tendency of the magnetic

*Paper read at the twelfth annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 20-22, 1904.

flux through any pole to change in intensity or position. Electric dampers are nothing but electrical dash pots. Referring to Fig. 1, previously discussed, if the load is a synchronous load in which the synchronous machinery is furnished with dampers, we can find a mechanical analogy in Fig. 2 by seeing that the shaft is equipped with a dash pot, which resists sudden angular flexure.

With all the past difficulties, and it might be said that they are practically overcome, parallel operation of alternating current generators may be said to be standard practice except in cases where extreme nicety of regulation on lighting circuits is essential. In such cases generators in the station carrying such loads are separated from generators carrying power factor loads, but this separation is more on account of regulation than on account of any difficulties from surging of load arising from parallel operation.

The operation of connecting in parallel alternating current generators requires that the machines shall be in phase, at the same frequency, and also giving the same voltage. If thrown together under other conditions large currents will flow between the machines. A slight phase difference does not matter so much as the machines will pull each other into step, but at the cost of large cross currents. A slight voltage difference is also not a very serious matter.

In order to determine whether machines are in synchronism, the common method is to use lamps connected as in Fig. 4, which illustrates the principal of this method. A and B represent two single-phase generators, the leads of which are connected at a switch, through two series of incandescent lamps, D and E. It is evident that as the relative positions of the phases of the EMF.'s change from that of exact coincidence to that of exact opposition the flow of current through the lamps varies from a minimum to a maximum. If the EMF.'s of the two machines are exactly equal and in phase the current through the lamps will be zero, and as the difference in phase increases, the lamps will light up and will increase in brilliancy until the maximum is reached, when the phases are in exact opposition. From this condition they will decrease in brilliancy until completely dark, indicating that the machines are again in phase. The rate of pulsation of the lamps depends upon the difference in frequency, i. e., in the speeds of the machines, and by adjustment of the governor of the engine or water-wheel, or the tension of the belt, the rate can generally be reduced to as low as one pulsation in ten seconds, which affords ample time for throwing the switch connecting the generators in multiple.

Fig. 4 shows connections for paralleling low-voltage single-phase generators. For high-voltage single-phase generators con-

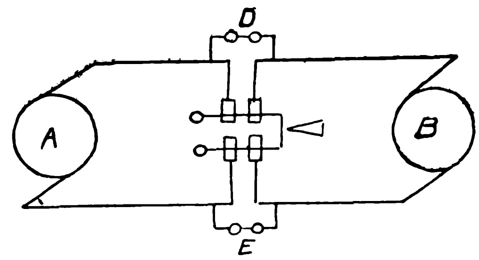


FIG. 4.

nections are as shown in Fig. 5. For synchronizing polyphase generators, the method is practically the same, when lamps are used, one phase of one machine being synchronized with the same phase of the other machine.

Although lamps are quite generally used for synchronizing, still the most satisfactory method is to use a synchroscope. A synchroscope is an instrument designed for this purpose and has the advantage of the lamp method because it shows the slightest difference in phase or frequency, whereas lamps do not. Since the ordinary incandescent lamp will not glow unless 40 per cent. or more of its rated voltage is applied, the dark period of the lamps when being used in synchronizing is quite long. The operator has to interpolate a succession of lamp brightness when using lamps for synchronizing, and if he throws the machine together at the wrong period of the dark interval, he may do so when there is a considerable difference in phase between the respective circuits.

The synchroscope indicates whether the incoming machine is running too slow or too fast; it indicates also the amount

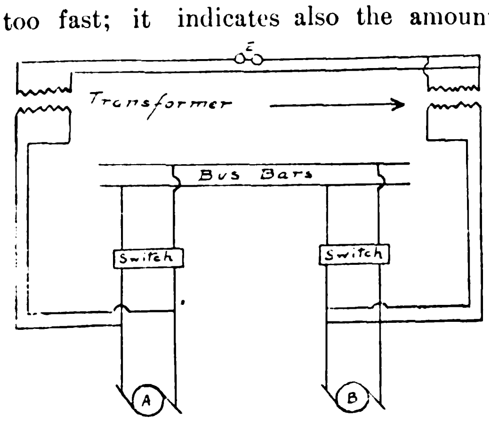


FIG. 5.

by which it is too slow or too fast, and it indicates the exact instant of synchronism.

The characteristics of the winding of an a. c. generator depend on the nature of its load. Characteristics of systems of distribution depend also upon the load which they supply. Practice has about settled into these lines.

As to frequency: For lighting only, 60 cycles per second, 7,200 alternations per minute; for lighting and power, 60 cycles; for power alone, 25 cycles, 3 alternations per minute; for incandescent lighting alone we may expect to find for some time to come high frequency plants, such as 133 cycles, 16,000 alternations, although these are rapidly passing away due to the fact that arc lights can not be operated at that high frequency with unqualified success, and due also to the fact that high frequency is not suitable for power work. It does, however, permit of transformers being built with less weight for the same core loss than lower frequencies. Then, too, a high frequency machine is not adapted for direct connection to engines of low speed, for example, a 16,000 alternation machine would require 160 poles if run at Corliss speed of 100 r.p.m. This would be a monstrosity.

One hundred and thirty-three cycles, 125 cycles, and other high frequencies were first used in central stations which carried only an incandescent load on a single-phase system, using high speed, belted generators and cheap air cooled transformers. As before stated plants of this character are rapidly passing away. Central stations nowadays look for a motor load so that they may run during the daytime, and the alternating current series inclosed arc system is being installed everywhere, so that what the central station man wants now is a generator which is suitable for supplying current for any class of service he has, arcs, incandescents or motors. This he can find in the 60 cycle generator, for this frequency is not too high for power either in motors or rotary converters, and it is about the lowest allowable frequency for successful operation of arcs and incandescents. Incandescent lights on lower frequencies show a fluctuation in light intensity, which, if not exactly visible, is nevertheless felt by the eye. An arc lamp to work on 25 cycles or thereabouts has not yet been perfected. The lower frequencies, such as 25 cycles, greatly shorten the life of Nernst lamps. There have been polyphase incandescents brought out in which there was a film in each phase, thus overcoming the light fluctuation by virtue of "heat inertia." No great success, however, has attended the exploitation of such wares.

For a pure and simple power proposition, 25 cycles has come to be standard. It gives low speeds for motors, and al-

though rotaries are successfully built and operated on 60 cycle systems, still the design of the 25 cycle rotary is less difficult and expensive. In generators, synchronous motors, rotary converters, low frequency means fewer poles for the same speed, consequently cheaper construction. All this tends toward simplicity. On the other hand, however, low frequency means larger and more simply designed static transformers in order to keep core losses down.

It is possible that future developments in traction work may call for a lower frequency than 25 cycles. The Washington, Baltimore & Annapolis road, using single phase motors on its cars, will have a system operating at 2,000 alternations, 16⅔ per second, but a line of single-phase street car motors for 25 cycles is now on the market. Frequencies such as 40 and 50 cycles have been exploited and abandoned. There is quite a good deal of 30 cycle apparatus and some 26⅔ cycle. Everything considered, however, 25 and 60 cycles have won out in their respective fields so far.

As to the choice of number of phases: All lighting work is single phase, whether circuits be taken from single or polyphase generators. Stations carrying an incandescent lighting load with no prospect of ever having a power load should use single phase apparatus. As long as there are such stations, we may expect to find standard lines of single phase generators. As single phase distribution is not suitable for the operation of motors it is necessary in a station carrying a mixed load to use polyphase generators, which supply different systems of feeders, polyphase feeders for power circuits and single phase feeders for lighting circuits. The balancing of the load on the different phases of such a machine is a question of some moment. It is therefore a problem to be considered in each installation whether or not two or three-phase shall be used. Three-phase distribution for power calls for about three-quarters of the copper which would be used in two phase distribution. On the other hand it is easier on a lighting load to keep two phases balanced than it it is to keep three phases balanced, and the lowering transformer equipment is more expensive in three-phase distribution. For a station, therefore operating a mixed load where the lighting load predominates, two-phase is far better than three-phase. When the power load increases to a point where 25 per cent. of the copper in that branch of the service becomes a considerable item, and amounts to more than the saving in transformers, then three-phase distribution is the proper thing to use. The extreme of this case is a plant carrying power alone and only a few incidental lights, as in an industrial plant.

For transmission lines three-phase is universally adopted, although in stepping down for distribution from transmission lines the current is very often changed to two-phase in order to obtain the benefits of better regulation. This change from two-phase to three-phase, or vice versa, is obtained by what is known as the "Scott system of connecting transformers."

In switchboard work the oil type switch has come to stay. The tendency in low voltage power work is to do away as much as possible with circuit breakers or even fuses, tying everything in tight, the self-induction of the machinery itself saving it from damage by short circuit. Where circuit breakers are needed in alternating current work, the tendency is to equip them with time elements so that they do not act unnecessarily. The limit of the hand operated switch is about 3,000 to 4,000 kw. at 2,200 volts. When generating units or feeders go beyond that capacity or that voltage, power operated switches are necessary. Pneumatic control was first used and now electrically operated distant control switches are the proper thing to use. Switchboard practice, however, is a subject inexhaustible in itself.

In the field of very high voltages there is much yet to be learned. Thorough protection from lighting and static discharge has been worked out, but that is a subject large enough for separate treatment.

Modern practice dictates that all small service transformers shall be of the oil insulated type because of its better ability to stand static strains in lightning storms, which used to play havoc with the old dry transformer. The oil type transformer also runs cooler than the dry transformer.

Although there are a great many core type transformers in use and although they are still being offered for sale, the preponderance of opinion, both in the trade and among consumers, seems to be that the shell type is the better, having less magnetic leakage, hence better regulation, having a further separation of points in the windings, differing greatly in the potential than the core type because there are less turns per layer in its coils. The shell type is more easily repaired in case of break down.

We can undoubtedly say that the single-phase transformer is best and that the three-phase transformers will never be more than a specialty. For a slight saving in the case and core the user of a three-phase transformer has sacrificed the advantage of universal application. In case of break down of one winding all must be taken out of service. In case of the loss of a power customer, the three-phase transformer is of use only in a similar service, whereas three single-phase transformers withdrawn from service in this manner can be used singly elsewhere on the system.

Large transformers for transmission lines are built in three different types. One type is the oil-insulated, self-cooling. This transformer has a corrugated case to increase radiating surface. It is made in sizes up to 500 kilowatts. In larger sizes such transformers are oil insulated, but they are cooled by water which is circulated through a coil of pipes immersed in the insulating oil. The third type is the air blast transformer which is made in all sizes. This transformer is built with air ducts through the core, a blower being used to force air through them to carry off the heat losses. So far as it goes in range of size, up to 500 kilowatts, the oil-insulated self-cooling transformer is best, for there is no cooling agent to depend on. If the heat losses are too great to be carried away by simple radiation, it would seem that water cooling is better than air cooling.

While there may be mooted questions as to the comparative merits of other alternating apparatus, we all agree that the induction motor is the ideal motor. Nothing could be more simple. For constant speed it has no equal.

The induction motor is essentially a constant speed motor just as the shunt wound direct current motor. Nevertheless it is being applied to variable speed work. It answers every purpose for hoisting work, for crane service, elevators, transfer and turn tables. When the load does not continue for a very long time, full load torque and much greater torque at very low speeds can be maintained. There are two methods of securing such speed control. One is to vary the voltage at the primary terminals of a motor having a secondary closed on itself, but having a somewhat higher resistance than the "squirrel cage" winding. This resistance is so proportioned as to give maximum torque at zero speed. Since the torque exerted by such a motor is proportional to the square of the voltage applied, any speed at any torque can be secured by applying the proper voltage, which is secured through a controller from taps brought out from auto converters. The efficiency of the motor at any speed is approximately equal to the ratio of that speed to synchronous speed.

It will be, in fact, a little less. The other method of speed control is to put a winding in the secondary of the motor with collector rings and brushes, which carry off the induced currents to resistances which are varied in value to a controller. This method is slightly more efficient at low speeds, but no more efficient at or near full speed where such motors are usually run in service for any length of time. It has the disadvantage of complicating the motor, turning a rough and ready piece of machinery into a delicate piece of electrical apparatus.

A third method of obtaining speed variation in an induction motor is to change the number of poles in the primary winding by a suitable controlling switch. The fewer the poles the higher the speed. This is the most efficient method, but it introduces too many complications and costs so much in construction that it cannot be said to be standard practice.

Synchronous motors are the exception, not the rule. Even in large units, where their only possible utility lies, they are being discarded for large induction motors. Simplicity is again winning. The synchronous motor has one virtue—constant speed (if generator speed is constant)—but many faults; inability to start under load; inability to vary speed; lack of flexibility; lack of stability under overload. Auxiliary apparatus is necessary, an exciter, a starting motor or compensator. A valuable feature claimed for the synchronous motor is the ability to control its power factor by varying the field excitation. Thus the power factor of a system may be brought to unity, but at a cost no less than that which would have been entailed by the power factor so improved. This feature is of questionable value where the power factor of the circuit varies or where the synchronous motor is controlled by some one other than the operator of the central power house.

Alternating current arc lamps are standard practice to-day in street lighting, because their use enables the central station to use one system for all classes of service, the same generators furnishing current for arc lights, incandescent lights and motors, whereas the old central station had a generator for each kind of load. High generating efficiency is here secured also as compared with the very low efficiency of the direct current series arc machine.

The induction wattmeter deserves mention. This instrument for recording power generated and power furnished is essential in every power plant and for public service corporations and in every customer's house or building. The induction wattmeter has been brought to a high state of perfection and has superseded all the other types.

It has been the purpose of this paper to point out some of those things in which common experience has shown what is the best kind of apparatus to use to meet ordinary requirements in different classes of service. When I say "common experience" I mean the experience not only of the manufacturers but of the users, and such experience is not to be disregarded.

Proposals Invited.

Sealed proposals are being invited until April 19 for furnishing the navy yards at Portsmouth, N. H., and Boston, Mass., with a quantity of arc lamps, rubber-covered wire, conduit and fittings, switch box and other electrical supplies. Bids must be made on Government blanks, which may be obtained upon application to the navy pay offices in Portsmouth and Boston, or the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

The Secretary of the Interior is inviting sealed proposals until May 5 for furnishing such electrical supplies as may be required by the Government Hospital for Insane, the Geological Survey, Howard University and the United States Capitol, during the next year. Blank forms will be furnished by the Secretary of the Interior, Washington, D. C.

Sealed proposals are being invited until May 5 for furnishing the Government Printing Office with electrical supplies during the next fiscal year. Schedules may be obtained from the Public Printer, Washington, D. C.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 5, 1904.

Electric Railways and Appliances.

756,316. Electromagnetic Railway Switch. Rollin A. Baldwin, South Norwalk, Conn., assignor to the Baldwin & Rowland Switch Company. Filed Dec. 18, 1902. Renewed July 24, 1903.

756,392-756,393. Wheel Guard or Fender. David McCausland, Detroit, Mich., assignor to the Briscoe Manufacturing Company, same place. Filed Oct. 5, 1903, and Dec. 1, 1903.

756,395. Traction-Wheel. James P. McEwing, Drayton, Canada. Filed May 8, 1903.

756,411. Car-Fender. Albert G. Roberts, Peterborough, Canada. Filed Aug. 17, 1903.

756,511. Electric Railway. Thomas D. Lovell, Beverly, Mass., assignor of one-half to Joseph F. Flanagan, Boston, Mass. Filed Nov. 3, 1903.

756,523. Automatic Power Cut-out for Electric Railways. Harry F. Pieper, New York City. Filed Jan. 5, 1904.

756,547. Trolley-Pole. Edwin A. Wakefield and George W. Morse, Mechanic Falls, Me. Filed Dec. 18, 1903.

756,550. Trolley. Charles M. Wilson, St. Louis, Mo. Filed Feb. 18, 1904.

756,757. Third-Rail Electric-Railway System. John D. Wilkens, Chicago, Ill. Filed July 24, 1903.

Electric Lights and Appliances.

756,516. Automatic Electric Cut-out. Guy Milburn, Baltimore, Md. Filed March 31, 1903.

Electrical Machinery and Apparatus

756,335. Current-Motor. Felix H. Crago, Billings, Mont. Filed Oct. 28, 1903.

756,344-756,782. Circuit-Breaker. Leonard L. Elden, Boston, Mass., assignor of one-half to Sears B. Condit, Jr., Somerville, Mass. Original application filed June 20, 1901. Divided and last application filed Dec. 10, 1903.

756,349. Transmission-Gear. Lee A. Frayer, Columbus, O., assignor, by mesne assignments, to the Oscar Lear Automobile Company, same place. Filed Aug. 17, 1903.

756,445. Rheostat. Henry J. Wiegand, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, same place. Filed June 1, 1903.

756,502. Mechanism for Removing Ice from Electric Conductors. Benjamin J. Jewett, Brooklyn, N. Y., assignor of one-half to Frederick H. Bartlett, same place. Filed Oct. 29, 1903.

756,513. Multiple Motor. Herman W. Martin, Ilion, N. Y. Filed March 2, 1903.

756,534. Circuit-Controller. Jacob L. Schureman, Jr., Chicago, Ill. Filed Jan. 11, 1904.

756,541. Electric Switch Peter Sorensen, Brooklyn, N. Y. Filed Nov. 23, 1900.

756,605. Current-Regulator. Emil Dysterud, Monterey, Mex. Filed June 9, 1903.

756,627. Insulator. John A. Hanson and Albert F. Lambert, Davenport, Wash. Filed June 14, 1902.

756,665. Apparatus for Testing the Insulation of the Coils of Electromagnets. James Livesey, Fall River, Mass., assignor to himself and Robert Healy, same place. Filed Feb. 1, 1904.

756,711. Electric Controller for Alternating Currents. Robert P. Rukenbrod, Turtlecreek, Pa. Filed Jan. 26, 1903.

756,724. Insulator. John C. Snodgrass, Steubenville, O. Filed Aug. 26, 1903.

756,793. Electrical Induction-Machine Hans Lippelt, New York City. Filed Jan. 13, 1903

Telephones and Telephone Apparatus

756,296. Selective Signaling for Polystation Telephone-Circuits. Burdett Stryker, Washington, D. C., assignor to the American Telephone & Telegraph Company. Filed April 30, 1903.

756,331. Spring-Jack for Telephone Switchboards. Merritt S. Conner, Chicago, Ill Filed Jan. 5, 1903.

756,424. Secrecy System for Telephone Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company. Filed Dec. 14, 1901.

756,436. Telephony. John Trowbridge, Cambridge, Mass. Filed May 18, 1903.

756,437. Telephone. John Trowbridge, Cambridge, Mass. Filed May 18, 1903.

756,508. Telephone Attachment. Gabor Konigstein, San Francisco, Cal., assignor of one-half to Joseph Silverman, same place. Filed Sept. 8, 1903.

756,608. Annunciator. Franklin H. Elwell, Chicago, Ill. Filed July 9, 1902.

756,777. Electrical Annunciator. Albert Carliss, Chicago, Ill., assignor to the American Electric Telephone Company. Filed Oct. 5, 1901.

Miscellaneous.

756,219. Wireless-Telegraph Receiving System. Eugene Ducretet, Paris, France. Filed Aug. 14, 1903.

756,223. Process of Treating Low-Grade Ores and Tailings by Electrolysis. Ernst Fahrig, Philadelphia, Pa. Filed May 9, 1903.

756,242. Electric Heater. Robert Kuhn, Detroit, Mich., assignor to the United Electric Heating Company, same place. Filed Oct. 7, 1902.

756,275. Electric Signaling Device for Elevators. Fred S. Payne, Boston, Mass. Filed Aug. 11, 1903.

756,408. Call or Alarm Device for Hotels or Other Buildings. Harvey Reed, Minneapolis, Minn., assignor of one-third to William M. Stone, same place. Filed Sept. 4, 1902.

756,441. Massage Apparatus. Arthur Ward, Philadelphia, Pa., assignor to the Electric Thermo-Vibra Company, same place. Filed July 20, 1903.

756,444. Electric Elevator. Harold R. Wellman, New York City, assignor of one-third to Edward S. Isham, same place. Filed June 30, 1903.

756,468. Code-Index. Charles G. Burke, Brooklyn, N. Y., assignor of seven-tenths to John Q. A. Whittemore, Boston, Mass. Filed May 26, 1902. Renewed Aug. 4, 1903.

756,718. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor, by direct and mesne assignments, to the International Wireless Telegraph Company and Marie V. Gehring, same place. Filed Aug. 9, 1902.

756,719. Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor, by direct and mesne assignments to the International Wireless Telegraph Company and Marie V. Gehring, same place. Filed Aug. 19, 1902.

THE TELEPHONE WORLD.

Independent Telephone Supply Plant.

A conference of the Interstate Independent Telephone Association has been held in Chicago for the purpose of organizing a telephone supply company with a capital of $1,500,000. The Interstate Association controls several hundred of the smaller Independent companies throughout Illinois, Indiana, Ohio, Michigan and the surrounding States. The plan, so it is stated, is to merge two small concerns at Indiana Harbor, and use them as a nucleus around which to build a big plant that can supply material to all the Independent telephone companies throughout the country.

Officials of the Chicago & Alton Railroad have decided to install telephone lines at all the principal side tracks along the main line between Chicago and St. Louis. These lines will be the length of the siding and will enable a freight conductor at one end of the siding, perhaps two miles distant, to talk to the operator at the station at the other end, and ask for instructions about proceeding. It will save a vast amount of delay, which has occurred in the past and which was caused by conductors walking from one end of the long siding to another. The telephones are to be installed in heavy boxes attached to telegraph poles, and which will be protected by switch locks to keep mischievous persons from tampering with them. The conductors will be able to converse with the agents or operator upon any matter of importance, which will save a long walk.

J. C. Hume, secretary of the Mutual Telephone Company of Des Moines, Ia., has purchased a new multiple switchboard and closed the deal for financing the company. J. H. Hill, of the directory board, stated the Ninth and Locust street location for the building undoubtedly will be chosen. Architects are figuring on plans for the building, the cost of which will be in the neighborhood of $30,000.

The American Telephone & Telegraph Company now has accountants at work preparing a statement to determine the benefits to accrue to the Western Union Company under the decision whereby the United States Circuit Court of Appeals of Massachusetts decreed that the Western Union was entitled to an accounting for shares of stock in the companies licensed by the Bell Company under the contract made in November, 1879.

A number of Independent telephone men of the United States Telephone Company and branch stations between Dayton and Richmond, O., have recently been in the former city in conference for the purpose of constructing a line between the two places. This will give Independent telephone service to Indianapolis and St. Louis.

The Ulysses Co-operative Telephone Company of Jacksonville, N. Y., has the following directors: R. A. Miller, A. H. Wood and Walter Mekeel, all of Jacksonville.

The People's Rural Telephone Company will build its first line from Swedesboro to Mullica Hill, N. J., as soon as contracts can be awarded and material procured.

Steady Growth of Keystone Company.

According to a report from Philadelphia, Pa., the Keystone Telephone Company's earnings for the quarter which closed with March were the largest it has had. The figures were $78,910, against $41,315, for the same quarter last year. The first quarter of the company's existence, the earnings were $19,390, and there has been a gradual advance ever since.

Gainesboro Company's Extensions.

The Gainesboro Telephone Company of Carrollton, Ga., has recently made great extensions in its property. The absorption of the Commercial Telephone Company of Atlanta, with its 90 miles of wire from Atlanta to Jackson and from Atlanta to Senoia, together with links and branches constructed in other parts of the adjacent counties, and the installation of several large exchanges in the towns and cities on its line, made necessary a large office force at the headquarters in Carrollton, and two large apartments have been added to the general office and an assistant secretary and a general auditor employed.

Articles of incorporation have been filed with the Secretary of State for the Renville, Minn., Rural Telephone Company with a capital stock of $20,000, and with authority to connect a number of towns under 2,000 in population by means of rural telephone lines. The towns to be connected are Fairfax, Franklin, Morton, Renville, Olivia, Bird Island, Hector and Buffalo Lake. The incorporators are A. E. Carver, A. E. Rieke, S. W. Smith, Paul Albrecht and C. W. Parsons, of Fairfax, and O. W. Harris and R. E. O'Keefe, of Franklin.

The Whitesboro branch of the Utica, N. Y., Home Telephone Company was put into operation a short time ago, and soon New York Mills and Yorkville will be included in the system. The line is being carried on to Oriskany and will be ready for operation probably by the last of the month. This additional service will be greatly appreciated and is the source of considerable gratification.

Corporation Counsel Duvall has given an opinion to the commissioners of Washington, D. C., to the effect that the Chesapeake & Potomac Telephone Company may charge whatever rate for messages it pleases at the toll stations in that city and in the suburbs. The subject, he says, is uncontrolled by legislation.

The rates of the Franklinville, N. Y., Telephone Company have been advanced from 33⅓ to 50 per cent. The company claims not to have made expenses during the past five years, though the officers have served gratuitously. The new rate is $12 per year for business places, and $9 for residences.

The Seneca Telephone Company of Gibsonburg, O., will operate a telephone system in the counties of Seneca and Sandusky on $20,000 stock.

The Naples Telephone Company has been organized at Naples, Me. Its capital stock is $10,000. J. P. Fickett is president and treasurer.

New Mexico Indians to Have Telephones.

Superintendent Allen, of the Indian School at Albuquerque, has a telephone system for the Indians of the Laguna and Acoma pueblos, situated in Valencia County, under advisement, and that some 46 miles of wire will be strung, and the Indians provided with the greatest of all American conveniences—the telephone. He suggested the plan to them and they were delighted and will do all the work of installing the line, and the Government will be put to but the small expense of furnishing the wire and instruments.

The line will run from Laguna to McCartys, 18 miles; from McCartys to Acoma, 12 miles; Laguna to Pahate, a side line, 10 miles, and Laguna to Mesite, another side line, 6 miles. It will be exclusively for the use of the people of the pueblos. The Indians have always marveled at the telephone and they have already started the work, so enthusiastic are they, and as soon as Mr. Allen can hear from Washington he will start building the line in earnest. It will be the first Indian telephone line in the United States.

There are plenty of telephone lines in the Indian Territory used by the so-called civilized tribes, but this is the first system installed for the use of the bona fide reservation redskins.

The Pleasant Valley, N. Y., Telephone Company has been incorporated to connect Earlville, East Hamilton, Hamilton Village and other points in Chenango, Madison and Oneida Counties. The directors are C. Frank Foster and L. W. Knapp, of Earlville; George W. Berry, of Poolville; C. S. Munson, of East Hamilton; H. C. Williamson and S. A. Fitch, of Hamilton.

At a mass meeting of citizens of Nuckolls County, held recently at Nelson, Neb., the Nuckolls County Telephone Company was organized with a capital stock of $50,000. The company will establish a system of rural telephones throughout the county.

The Pelican Telephone Company, organized to operate a telephone exchange in Pelican Rapids, Minn., and other adjacent territory in Otter Tail County, has a capital stock of $25,000, and its officers are: J. P. Wallace, president; C. M. Carr, vice-president; N. P. Meen, secretary, C. L. Ward, treasurer.

Telephone Incorporations.

The New York Automatic Telephone Company, Passaic, N. J. Capital stock, $1,000. Incorporators: Charles R. Newman, George Roegner and Adolph C. Gilgen.

The Utica Telephone Company, Utica, Wis. Capital stock, $5,000. Incorporators: J. G. Pickett, A. Parks, R. W. Mackie and W. F. Muncil.

The Mondovi Telephone Company, Mondovi, Wis.—to construct and own telephone lines. Capital stock, $240,000. Incorporators: B. S. Lockwood, George A. Duetscher. S. D. Hubbard and C. W. Gilman.

The Dundee & Crystal Springs Telephone Company, Dundee, N. Y. Capital stock, $5,000. Incorporators. Delmar J. Knapp, L. Pitcher, Ed. J. Bailey, all of Dundee.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Anadarko, Okla.—The election held here recently to vote on the proposition to issue bonds to the amount of $30,000 for a sewer system and electric light plant was carried.

Baltimore, Md. M. Solmson & Co., of this city, are erecting a woodworking plant and are in the market for woodworking machinery, a 50 hp. engine, electric light plant, etc.

Bartlett, Tex.—It is reported that the council will be petitioned for an electric light plant franchise. Power would also be supplied to Granger and Holland.

Bedford, O.—The People's Electric Light Company has been acquired by E. A. Mandeville and Edward Roberts, who represent a Philadelphia syndicate. The plant will be enlarged.

Breckenridge, Mo.—O. J. Chapman, mayor, says that a vote will be taken on the construction of a $10,000 electric light plant.

Buchanan, Mich.—Electric lighting is favored by the recently elected town officials, of which B. R. Desenberg is president.

Dayton, O.—The board of public service has ordered additional arc lights placed at various street corners.

Farmington, Mo.—George M. Wilson, mayor, states that an electric light plant will be constructed. Samuel L. Asbury is city engineer.

Greenville, Mich.—Several councilmen favor a plan to issue $26,000 bonds for a municipal electric lighting plant.

Guadalajara, Mex.—The municipal authorities have made a new contract with the local electric light company to very largely increase the public lighting of the city, which has become absolutely necessary.

Hannibal, Mo.—The Electrical Supply Company of St. Louis will erect an electric light and power plant here.

Harvard, Neb.—J. J. Keefe has been granted a 20-year electric lighting franchise.

Henning, Ill.—Robert Wilson, of this city, has purchased the Potomac electric light plant. He will at once make preparations to light this city with electric lights.

Hutchinson, Kan.—The Street Railway Company may install an electric lighting plant. Local business men are also considering a project to erect a plant.

Kendallville, Ind.—A new system of electric street lighting is under consideration. James Graves, mayor,

Lawrenceburg, Tenn.—An electric lighting proposition is under consideration by the town board.

Limestone, Me.—Active steps will soon be taken to have an electric light plant installed here.

Naples, N. Y.—W. H. Tobey, a business man of this place, has obtained from the village fathers a franchise for the erection of poles and the stringing of wires for the purpose of supplying electric light.

Neenah, Wis.—The Wisconsin Traction, Heat, Light & Power Company, of which John I. Beggs, of Milwaukee, is the head, has secured 10-year franchises for lighting this city and Menasha, each paying $5,000 apiece a year for lighting.

New Haven, Ind.—A municipal electric lighting plant is under consideration. J. M. Jackson, town clerk, may be addressed.

Omaha, Neb.—The Omaha Electric Light & Power Company will expend $75,000 in improving its plant. New machinery will be installed.

Roswell, N. M.—Maynard Gunsul, of Albuquerque, representing a company of New Mexico capitalists, of which he is a member, recently secured from the council of this city a 30-year franchise for an electric light and power plant here with a liberal 10 year contract from the city for all street lights needed.

Rulo, Neb.—This city has voted for waterworks and electric light bonds.

Shenandoah, Ia.—The Shenandoah Ice Company has been granted a 25-year franchise for a heating, electric lighting and power plant. Boilers will be required and other apparatus. Address W. F. Hand, manager.

St. Louis, Mo.—The Ada Electric Light & Power Company, lately incorporated with a capital of $40.000 by Allen B. Patterson, William F. Klanke and others, will operate light, power and traction plants.

Suttons Bay, Mich.—This town has a petition before it for granting a 25-year franchise to an electric light company.

Tannnersville, N. Y.—The electric light question is under discussion here. J. D. Hasbrouck, vice-president of the Otis & Catskill Mountain Railway, and Messrs. A. Atkinson and A. Anderson, electrical experts, are interested in the movement.

Topeka, Kan.—The council committee reports that $18,548 will be needed to enlarge the electric light plant to provide power for 75 new lamps. The plan is under consideration.

Yorkville, N. Y.—The issuance of bonds to the amount of $150 for additional electric street lights has been favorably voted upon.

Zacatlan, Mex.—An electric light and power plant is to be installed in this city, located in the State of Puebla. The plans have been submitted by the city council to the State Department for formal approval.

STREET RAILWAYS.

Almont, Mich.—Q. A. Thomas is interested in an electric railway to be erected here.

Anderson, Ind.—The survey of the proposed Anderson-Lebanon electric line, promoted by Wallace B. Campbell, will soon be made by the chief engineer for a New York firm, which has promised to back the project should the survey be satisfactory. The report will be passed upon by the Municipal Bond & Securities Company of Cincinnati.

Bangor, Me.—William D. Smith, of this city, will soon commence work on the construction in Rock Island of the Providence & Newport Electric Railroad.

Chester, Pa.—The Chester Traction Company will greatly improve its system.

Flint, Mich.—The council has given an electric street railway franchise to T. E. Tarsney, T. Nester and J. Russell, of Detroit, for the Detroit, Flint and Saginaw Line, to connect with the Detroit United in this city.

Fresno, Cal.—The Fresno Traction Company will vote May 18 on the issuing of $5,000,000 for extensions.

Geneva, Ind.—The Geneva Traction Company has been organized by fifty residents of this place with a capital stock of $2,000. The company intends to construct an electric railroad, running from here through the counties of Wells and Blackford, terminating on the west at Montpelier. On the east the line will be extended to Celina. O. The directors of the company are Charles D. Porter, J. H. Hordison, D. M. Shively, A. G. Briggs, E. F. Walsh, S. W. Hale and W. J. Heenter.

Glens Falls, N. Y.—The Keeseville, Ausable Chasm & Lake Champlain Steam Railroad is to be converted into a third-rail electric road. The plans have been completed and work is to begin soon. Power will be obtained from a dam across the Ausable River. A new turbine wheel will be installed and 1,200 hp. will be developed.

Indianapolis, Ind.—Fifty feet of the tracks of the Northwestern Traction Company were washed away by the recent flood.

Jackson, Miss.—The interurban electric railroad between Jackson and Vicksburg is going to be built by the Mississippi Land & Investment Company.

Kansas City, Mo.—G. M. Walker and W. B. Strang are promoting a new electric railway here.

New Haven, Conn.—President C. S. Mellen, of the New York & New Haven road, in outlining his plans for developing the electric system in this city, which the road that he represents has just acquired at a cost of $7,000,000, announced last week that through trolley service between this city and Waterbury without change of cars would be established soon.

Palo Alto, Cal.—This city is to have a new electric railway. J. F. Parkinson is the holder of the franchise.

Platteville, Wis.—Patrick Flynn states that a new electric road will be built here this summer.

Smyrna, Pa.—Superintendent Letherbury, of the Middletown & Odessa Electric Railway Company, and E. R. Cochrane, Jr., are engaged in securing the options on the land for the right of way for the extension of that line from Middletown to this place.

Springfield, Ill.—A. G. Kingman is interested in the electric road to be built from this city to Peoria.

POWER PLANTS.

Defiance, O.—M. W. Steinberger, engineer, states that a plant for developing water power on the Auglaize River will be erected soon.

Fremont, O.—The Fremont Power & Light Company, with capital stock of $350,000, has been incorporated by Henry Boozer, of Waterloo, who will establish a water power electrical plant in Belleville, one mile south of Fremont on the Sandusky River.

BIDS WANTED.

Hillsboro, O.—Sealed proposals will be received by J. C. Sprague, chairman of the light committee of the village, until April 30, for the furnishing of electric arc lights for the public lighting; also incandescent lights for private consumers for a period of 10 years. H. P. Morrow, president of council; C. D. Doggett, clerk.

NOTES FCR INVESTCRS.

Latest quotations for copper are: Electrolytic, $13\frac{1}{8}$@$13\frac{1}{4}$c.; Lake $13\frac{1}{4}$@$13\frac{3}{8}$c.; casting, 13@$13\frac{1}{8}$c.

Electric Storage Battery advanced $1\frac{3}{4}$ points in Philadelphia on Monday, later receding $\frac{3}{4}$ on the sale of an odd lot.

The Brooklyn City Railroad Company has declared the regular quarterly dividend of $2\frac{1}{2}$ per cent., payable April 15.

The capital stock of the Crocker-Wheeler Company, of Ampere, N. J., is to be increased from $1,000,000 to $2,000,000.

The New Jersey Short Line Railroad has let a contract for 36 miles of double track electric railway on the short line from Philadelphia to New York for $2,225,000.

From July 1 to March 31 the gross earnings of the Brooklyn Rapid Transit Company show an increase of about $900,000, as compared with the same period last year.

The United Traction Company of Albany, N. Y., has declared the regular quarterly dividend of $1\frac{1}{4}$ per cent., payable May 1. Books close April 20 and reopen May 2.

It is understood that Judges Grosscup and Jenkins of Chicago now have the full case of the ninety-nine year franchise arguments under review. A decision in the case is expected next week.

The United Electric Securities Company of Boston has declared its regular semi-annual dividend of $3.50 per share, payable May 2 to stock of record April 20. The books do not close.

The Milwaukee (Wis) Electric Railway & Light Company has declared the regular quarterly dividend of $1\frac{1}{2}$ per cent. on its preferred stock, payable May 2. Books close April 20 and reopen May 3.

Owing to the sharp advance just before the close of the market in Wall Street on Monday Brooklyn Rapid Transit advanced to $48\frac{1}{8}$, where it closed with a net gain for the day of two points.

The United Traction Company of Albany, Troy and Cohoes, has made application to the New York Railroad Commission for permission to issue the mortgage of $6,500,000 approved by the stockholders.

The Northern Electric Company of New York was incorporated at Albany on Monday with a capital stock of $10,000. The directors are T. J. Ryan, Lucien Barnes, Jr., and G. A. Schriefer, of New York.

The Union Traction Company of Columbus, O., has amended its charter so as to increase its capital stock from $10,000 to $700,000. It is to operate electric lines from Cincinnati to Toledo, Columbus and Zanesville.

The Hudson River Telephone Company, Albany, N. Y., has declared the regular quarterly dividend of $1\frac{1}{2}$ per cent., payable April 15. Hereafter dividends will be paid on January 15, April 15, July 15 and October 15.

While there is less active buying of copper on either domestic or foreign account, the market continues strong at full prices; in fact it is difficult to buy even small lots at inside quotations, while a round lot of any kind would be difficult to purchase this side of June.

The directors of the American Telephone Company have not reached a conclusion with respect to their financial plans. For some time they have been "sounding" important financial interests with respect to an issue of bonds, but to date they are not in a position to make a definite proposition to bankers.

ELEOTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Apr. 11
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	$143\frac{1}{8}$
Metropolitan Street Railway	$116\frac{1}{2}$
Metropolitan Securities	$81\frac{7}{8}$
Ninth Avenue	200
Third Avenue	$120\frac{1}{2}$
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	233
Brooklyn Rapid Transit	48
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	$63\frac{1}{2}$
Philadelphia Traction	96
Union Traction, $17.50 paid	$49\frac{5}{8}$
Boston.	
Boston Elevated, full paid	$139\frac{1}{4}$
West End Street, com	93
do. do. do. pref	$111\frac{1}{2}$
Chicago.	
City Railway	161
North Chicago	87
Union Traction, com	$5\frac{1}{2}$
do. do. pref	$30\frac{1}{2}$
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	23
do. do. pref	56
Electric Lead Reduction	$\frac{7}{8}$
Electric Vehicle, com	7
do. do. pref	10
Westinghouse, com	159
do. pref	194
General Electric	$163\frac{3}{4}$
Boston.	
Edison Electric Illuminating	$237\frac{1}{2}$
General Electric	163
Massachusetts Electric Companies, com	20
do. do. do. pref	$74\frac{1}{2}$
Westinghouse Electric & Mfg., com	78
do. do. do. pref	89
Chicago.	
Chicago Edison	150
National Carbon, com	$29\frac{3}{4}$
do. do. pref	$100\frac{1}{2}$
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	59
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	$124\frac{1}{2}$
Western Telephone Company	8
New England Telephone Company	$120\frac{1}{2}$
New York.	
American Telegraph & Cable Company	$84\frac{3}{4}$
Commercial Cable Company	$191\frac{3}{4}$
Mexican Telephone Company	$1\frac{1}{2}$
New York & New Jersey Telephone Company	149
Postal Telegraph Cable Company	....
Western Union Telegraph Company	$86\frac{1}{4}$
Miscellaneous.	
Chicago Telephone Company	118
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	32
Consolidated Car Heating	64
Standard Underground Cable	200

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THE TRADE SUPPLIED BY THE AMERICAN NEWS COMPANY.

CONTENTS.

EDITORIAL NOTES.

An Article Worthy of Study. It is seldom that we refer in these columns to articles in the body of the paper. We do not as a rule believe in it because it takes up space which might advantageously be utilized for other matter. There are exceptions to every rule however. We therefore call our readers' attention to the first installment of a most interesting series of articles on the systematic classification of the underlying principles of wireless telegraphy, which will be found elsewhere in this issue of ELECTRICITY.

This resume, by the well-known writer Emile Guarini, from the noted address of the French scientist, M. Ferrie, is from the standpoint of simplicity, clearness and scope the best, we believe, of its kind ever published in our language, and it is well adapted to meet the desires of those of our readers who wish to keep posted in the development of this interesting and rapidly growing department of electricity, and it will undoubtedly "furnish food for thought" for many of our inventors who may have been somewhat blindly groping after a clear, well-defined base of operation.

* * *

Letter-Press Printing by Electrolysis. While investigating a process for letter-press printing by electrolysis without the use of ink (an extension of Bain's telegraphic printing) Mr. Charles R. Darling, of London, found that the final results of electrolysis—when the electrolyte forms only a thin film—often differ materially from those observed in an ordinary cell. In the course of his experiments, which he has lately brought before the Faraday Society for discussion, Mr. Darling used a carbon or metal plate (it was immaterial), which formed the anode; on this was placed an impression pad, consisting of some sheets of moist blotting paper; upon this was the trial sheet, carrying the electrolytic film, and on this the cathode type or coin. Voltages from 6 to 200 were employed. It was requisite, in order to obtain a clear image of the type, to use a certain minimum strength of solution. The first experiments were made with saline solutions; silver nitrates gave a clear, permanent black image of the type, but the paper of course darkened on exposure; copper sulphate and nitrate yielded images that faded after a time; the same unexpected result occurred with lead, mercury salts and bismuth. The best images were obtained with manganese salts. These consisted of the oxides or hydrates, and were thus quite permanent; all purely metallic deposits, excepting silver, disappeared after a time.

In the case of non-saline solutions, the paper, which might consist of asbestos or pure Swedish filter-paper soaked in distilled water, acquired the properties of an exposed photographic plate, and on treating with a silver salt and developer a perfect image of the cathode was obtained, even after a long interval. Mr. Darling showed productions of such electrographs to his audience. The latent images are not due to hydrogen peroxide, nor to metallic compounds as they occur with carbon electrodes, but they reside in the surface of the paper in contact with or towards the cathode. They are ascribed by Mr. Darling to a class of phenomena that have been investigated by Bose, and termed "the response of inert matter to electrical stimulus." He is of opinion that they are probably the result of some state of strain set up in the film by the current. It was remarked that the fading of the metallic images may be simply due to recombination, but that explanation

was not regarded as entirely satisfactory. A number of questions of interest were asked in the course of the discussion. Mr. H. J. Bluman said that in some experiments which he had carried out with electrolytic printing he had used some organic solutions with good results, but Mr. Darling replied that they eventually discolored the paper. In replying to other speakers he did not think hydrogen was the cause of the latent images, and certainly hydrogen peroxide does not destroy the image.

* * *

Growth of Electric Railways. Some idea of the wonderful growth of street railways in this country during the past decade, due principally to the introduction of electricity, may be had from some statistics published in Poor's Manual. In 1894, according to this authority, there were 13,176 miles of street railways in operation, whereas in 1903 there were 24,561 miles, or an increase in ten years of 11,384 miles.

This growth would not have occurred had electrical inventors not been constantly at work perfecting every detail of street railway apparatus. To what extent electric traction has increased during the years between 1894 and 1903 may be had from the following figures: In 1894 there were 1,950 miles of street railway operated by animal power, while in 1903 the mileage had been reduced to 281. In 1894 there were 578 miles of cable road while in 1903 there were but 267. In 1894 there were 10,238 miles of electrically operated roads, whereas last year there were 23,869 miles, an increase in ten years of 13,631 miles or more than double the mileage the country boasted of previous to 1894.

The distribution of traction mileage shows that more than half of it is confined to seven States. New York leads with 2,879 miles, while Ohio is a close second with 2,872 miles, followed by Massachusetts with 2,649, Pennsylvania with 2,487, Illinois with 1,901, California with 1,110 and Missouri with 835 miles. Of the horse traction remaining 124 miles are in New York, 43 in California, 34 in Pennsylvania, 14 in Illinois, 11 in Missouri, 8 in Massachusetts and none in Ohio. In fact, outside of a few centers where electrification is in rapid progress, horse traction has become obsolete. On January 1 of this year there were 267 miles of cable traction still in use but there was not a mile of it in this State. There is more of it in California, 82 miles, while important systems remain in Chicago, Philadelphia and St. Louis. Electricity having been demonstrated to be more economical than cables, it is fair to assume that it will rapidly replace the latter, except in cases where peculiar conditions make the cables more desirable.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

It costs the Brooklyn Rapid Transit Company more than $1,000,000 a year to pay the claims for damages which are made against it.

Signor Marconi, who is at present in London, says that, as soon as the agreement with the British Post Office is signed, the wireless service for Canada and the United States will be started.

The various organizations of employes of the elevated railroads in New York have voted to reject the pension plan proposed by the Interborough Rapid Transit Company.

The city of Alexandria, Va., is now arranging to sell its electric lighting plant to private parties. It owns an electric plant which supplies only arc lights and an old gas plant which furnishes gas for domestic lighting. The authorities will in a short time advertise for sale the exclusive franchise for using the streets for electric lighting and power.

The Chicago Telephone Company was dealt a stunning blow by Judge J. W. Mack on Friday last when the court held that the corporation was a tenant of the city as the city exists to-day and not as the city existed in area in 1889 when the company was given its franchise. The ruling was in the suit brought by the Alton Grain Company contesting for the telephone company's right to charge more than $150 for its service within the present limits of Chicago. The decision, if sustained, will also mean increased compensation to the city as the company is paying only on its earnings within the old limits of the city.

The Electric Railway Test Commission, which is composed of J. G. White, New York, chairman; H. H. Vreeland, W. J. Wilgus, and J. H. McGraw, New York, and G. F. McCulloch, Indianapolis, has announced the plans for the elaborate series of electric railway tests to be made during the St. Louis Exposition. On the grounds of the exposition the authorities will provide special tracks having an almost level grade and well ballasted, for the operation and testing of railway car and locomotive equipments. These special tracks consist of one section 1,400 feet in length, and one section 2,000 feet in length, the two sections being parallel. Upon these tracks it is proposed to carry on the greater part of the operating, acceleration, braking, coasting and motor-heating tests, as well as tests to determine car and train friction.

An English paper states that specimens of a new thorium ore have been discovered in Ceylon and forwarded by the Government of that colony to the Imperial Institute. The specimens received were small black cubical crystals, and it was at first thought that they were uraninite or pitchblende. The specific gravity of the mineral was found to be 9.32, and analysis showed that it was not pitchblende, since it contained only about 12 per cent. of uranium oxide and 75 per cent. of thoria.

It is stated that nine persons out of every ten who use the telephone hold the receiver to the left ear, and many find it impossible to hear over the telephone with the right ear. The fact that the majority of men and women are right-handed and that the constructors of the first telepones took due notice of this is responsible for this new condition of left-eared people.

Consul C. R. Slocum at Warsaw, Russia, reports to the Department of Commerce and Labor that the proposed electrical exhibition has been cancelled, owing to the belief of the promotors that pending the duration of the Russo-Japanese conflict such an exposition would not pay.

Another patent on a marine compass has recently been taken out by Lord Kelvin. According to the *Electrical Engineer*, London, the patent covers an improvement in the method of suspension to secure a steady card in spite of greater vibration due to higher speed in steamships. Another feature is the illumination of the compass at night entirely from the underside. This can be done either with electric light or by means of oil lamps. In either case adjustment in the intensity of the light is provided, as this has been found particularly useful when taking bearings from stars or other faint lights. A new form of helmet is now introduced having rifle sights upon the top. This helmet moves around freely in any direction, and bearings of the sun, lights, buoys or other objects are taken instantaneously and read directly upon the compass card.

THE LATEST PROGRESS IN WIRELESS TELEGRAPHY.*

BY EMILE GUARINI.

Translated for "Electricity" by Jean A. Wetmore, M. S., E. E.

A leading French authority, M. Ferrie, a member of the Central Commission of Wireless Telegraphy of the same country, and who is known as an author of very interesting works pertaining to this class of telegraphy, has just submitted to the Parisian International Society of Electricians a very remarkable paper under the above title, which is very worthy of attention in several respects. It is pre-eminently a very able resume of the present state of the subject and furthermore, we find among the observations and criticisms, the descriptions of new devices, those which may be of great practical and theoretical utility. But the most remarkable portion of M. Ferrie's paper pertains to the comparative study of the various systems and of the various methods, which are grouped around those systems, and what makes this dissertation more remarkable, and still more worthy of attention, is that it is not based solely on theoretical data, but upon results obtained from the comparative experiments made by the author with the various systems.

The progress made in wireless telegraphy during the last two years has been, according to M. Ferrie, of little importance, for, in spite of the numerous investigations and installations, made in various countries, the difficulties in its use have persistently remained the same as before.

In his opinion the numerous experiments made with the various devices have at least resulted in fixing in a concise way the present status for the possible conditions to be met in the practical development of tele-communication. Theoretical ideas are likewise well defined.

M. Ferrie has passed in review the various hypotheses regarding the propation of waves, but he rounds off the theory submitted by M. Blondel in 1898. In accordance with the latter, the antenna-earth system is the equivalent of a double length Hertz oscillator, obtained by the prolongation of the antenna O A, by a symmetrical part O A', which is considered as an "electrostatic image," in respect to the surface of the earth, while the latter plays the role of a surface conductor. The field created by this rectilinear oscillator is formed in all respects like the field investigated by Hertz, which surrounds a small rectilinear electric oscillator, forming and giving out a series of rings, which become detached and are carried perpendicularly to the wire of the oscillator, at the same time increasing in size (Figs. 1, 2, 3).

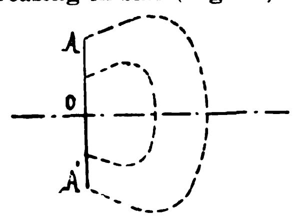


FIG. 1.

Several English and American writers have admitted that these rings are reduced to halves, the presence of the earth only permitting of the existence of the upper halves, which are carried along by a simple translational movement, maintaining meantime their relative contours (Fig. 4). According to M. Blondel this cannot be admitted, because the lines of force tend to extend in all directions; they consequently increase in height at

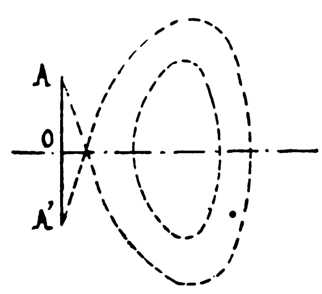


FIG. 2.

the same time as they move along the surface of the earth, on which they are normally supported (so to speak), at the same time they curve inward toward the vertical axis (Fig. 5), similar to the results obtained from the study, within short distances, of the Hertzian field.

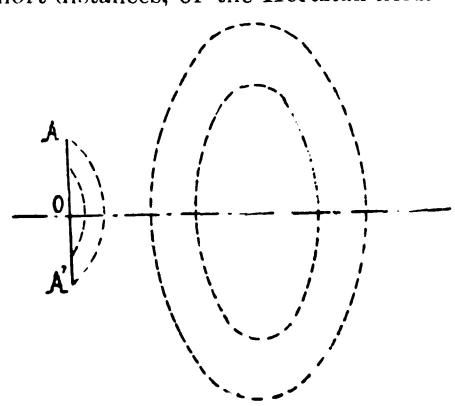


FIG. 3.

We should consequently represent the propagation of the lines of force in a diagrammatic manner, as shown by Fig. 5.

We will here remark that this theory must be considered as somewhat novel, rather than as a complement of the preceding theory, as stated by M. Blondel; whichever it may be there is a considerble difference between them. Although M. Blondel in his first theory admits of an electric perturbation, "an electric mist or fog," brought to a maximum at the height of the transmitting antenna, it actually admits of a propagation above the transmitting antenna, which hypothesis agrees in other respects with the experiments made by M. Ferrie in a liberated balloon and also with the investigations of others.

We would have liked very much to have had M. Ferrie discuss further the other proposed theories. Being certain of our more recent experiments, substantiating in effect the other belief, which is

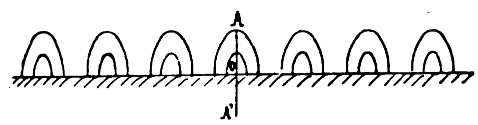


FIG. 4.

that contrary to the opinion, which he has held to for several years, the conductivity of the earth or of water on one side, and that of the atmosphere on the other, and that each plays its part at least over long distances. Concisely stated, it really is a circuit, composed of two conductors, water or the earth, and the atmosphere, which are in imperfect contact, similar, for example, to the rails of a railroad in the track circuit. The atmospheric layer, as it pertains to the phenomenon is, as M. Blondel states, in his first theory, limited to the heights of the antennæ.

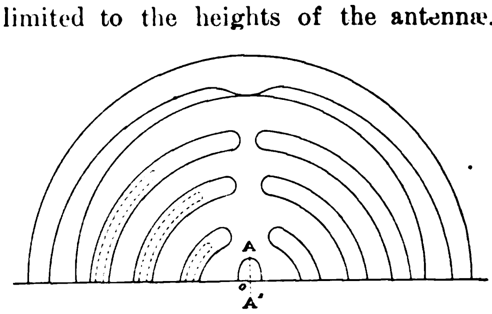


FIG. 5.

This does not prevent a propagation in all directions through an electrostatic and an electrodynamic induction. This induction is appreciable at relatively short distances, and it easily explains the effects produced in the free balloon experiments. Whatever it may be due to, M. Ferrie deduces, as a result of M. Blondel's new theory, that the energy transmission per unit of surface, varies proportionally to the factor

$$\frac{1}{\alpha^2}\;\frac{\cos^2\left(\frac{\pi}{2}\cos\theta\right)}{\sin^2\theta}$$

in which θ represents the angle of propagation with the vertical, and α the dis-

*Resume of a paper by M. Ferrie.

tance (Fig. 6). From this we find that the energy varies in inverse proportion to the square of the distance, and furthermore that it should decrease rapidly with the height above the horizon, but the effect produced upon the coherer is proportional to the energy produced in the receiving antenna and consequently to the energy per unit of surface. Furthermore, according to M. Ferrie, M. Blondel's new theory appears to be quite

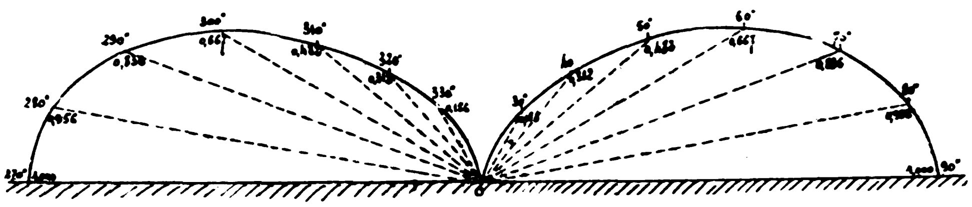


Fig. 6.

rational and in accordance with observed facts. Theoretical investigations have likewise been made for the purpose of determining the solution of the problem of syntonization in a scientific manner. The first attempts were made to accurately measure the period of the oscillations produced at the transmission end. The direct methods requiring delicate and complicated devices, being practically of little use, it is preferable to have recourse to indirect methods, which consist in employing an auxiliary circuit, which is placed in resonance with the discharging circuit, as has been done by Lecher and Hertz.

M. Drude made up the auxiliary circuit by using two parallel wires connected by a movable bridge, the Hertz resonator being then replaced by an empty tube in connection with the bridge. A different method was employed by M. Ferrie. It is known that every conductor connected in an oscillating circuit itself partakes of the vibration; the oscillations of which it forms a part, have their maximum amplitude when its electric elements

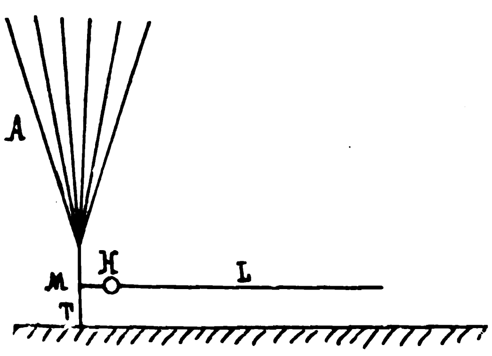


Fig. 7.

are such that its own period becomes equal to the period of the exciting circuit.

More specifically, if we connect a well insulated horizontal wire, L, to an antenna, A (Fig. 7), at a point, M, near the grounding point and a thermic amperemeter, H, be inserted in the horizontal wire near the point of derivation, and the antenna be put into a state of vibration, by any available means, the following facts will be observed: On progressively increasing the length of the wire, L, the intensity, as indicated by the amperemeter, will likewise progressively increase up to a very well defined maximum, afterwards it decreases to a value approaching zero, to afterwards again increase, and so on. The consecutive maximums and minimums are equally spaced and the absolute value of the maximum continues to rapidly decrease.

The effective intensities, as measured by the ampere-meter, are evidently those of the stationary waves which are produced in the horizontal wire.

The length of the wire, which corresponds to the first maximum, consequently represents a quarter of a vibratory wave movement of the antenna, since the horizontal wire and the antenna at this moment are in unison with each other. By employing at all of the stations and for all forms of antenna a horizontal wire identically the same, placed at the same distance from the ground, the quadruple of the lengths of the horizontal wire, corresponding to the first maximum, may be considered as the wave length.

This method, which M. Ferrie has employed for two years past, has been recently modified, and, we remark in passing, by M. Slaby, who replaced the auxiliary rectilinear wire by a solenoid. M. Ferrie believes that the results thus obtained are not in all cases comparable; at any rate M. Ferrie has proven by his method, using a captive balloon, that the rule of the quarter wave for antennæ, connected to a single wire, which are directly excited, are very appreciably exact, up to a distance of 800 meters. With antennæ of 800 meters length the frequency of the oscillations are not greater than 100,000. It is interesting to note that the properties of these waves are identical with those having a period of one hundred times greater. M. Ferrie believes that it is allowable to admit that it is the same for oscillations having a period much less. This was demonstrated by the writer of this article elsewhere several years ago.

According to his idea this provides an explanation for certain ruptures in alternating current transmission cables, which is explained by the formation of stationary waves, originating from the high harmonics.

M. Ferrie has also observed that the length of the wave noticeably increases with the number of wires composing the antenna, and especially with their separation.

If indirect excitations are employed in the transmitting instruments, i. e., the inductive method, it will be observed that the antenna vibrates in unison with the period of the exciter circuit, and it does not have a constant period but one of its own. This, in the writer's opinion, is of importance for the purpose of securing secrecy of transmission and explains the ineffectiveness of syntonization in the greater number of cases, since the same thing occurs between the transmitting antenna and the receiving antenna. The energy of the oscillations are evidently at a maximum when they are in unison and this unison may be found by adjusting the elements of the exciter circuit until the thermic ampere-meter, which is this time placed in the antenna circuit, near the

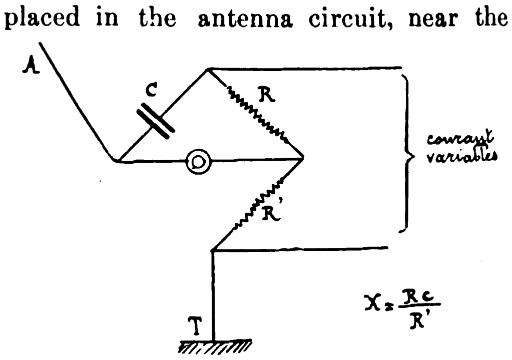


Fig. 8.

ground, indicates a maximum. We will also observe that the "intensity" is capable of attaining three or four effective amperes, by making use of induction coils, the maximum intensity of the oscillation is then in the vicinity of the 100 amperes.

It would be equally interesting, as M. Ferrie has observed, to compare the variation in capacity with the variation in the length of the wave, due to modification in the forms of antennæ, all of the same length. These capacities are easily measured in a sufficiently accurate manner by the Thomson or the De Santy methods, in which a telephone is employed as a zero device, using variable currents (Fig. 8), the latter being received in derivation from the terminals of a Rhumkorff coil primary, care being taken to insert into the shunt circuit some low capacity condensers or some strong self-induction.

It is thus observed that the capacities of ordinary antennæ are several 1,000th of a microfarad. For example, a single wire

antenna, 30 meters long, has a capacity of 25-100,000 of a microfarad. By varying the number and the separation of the wires, composing an antenna of given length, and by measuring the capacity in each instance, and the length of the wave, we observe, by applying the Thomson formula—if, however, it can be applied—that the self-induction varies but very little whatever may be the number of the wires.

(To be continued.)

ELECTRIC TIMIMG ARRANGEMENT ON THE "CRESTA" AT ST. MORITZ*.

Most people have heard of the celebrated "Cresta" toboggan run at St. Moritz, Switzerland, and many have seen it, but not so many are familiar with the electric arrangement by which the racing is timed accurately to the tenth of a second. Having regard to the unique character of this

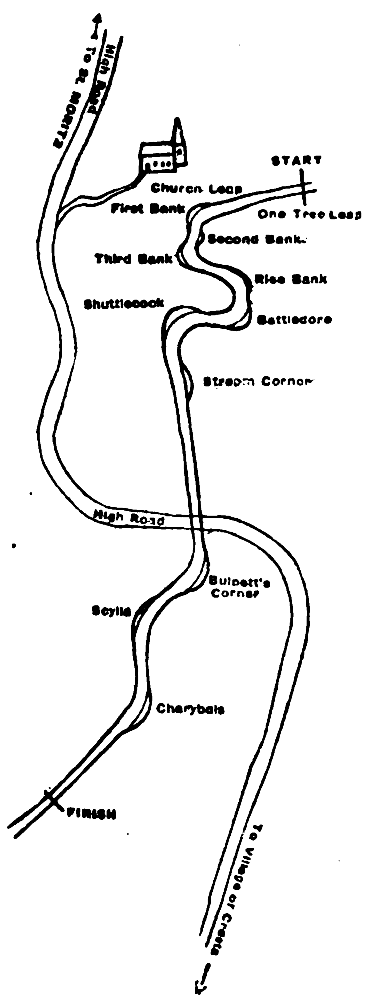


Fig. 1.

little installation, a description of the apparatus may be of interest to electricians.

St. Moritz is one of the highest villages in the Engadine, having an altitude of about 6,000 feet, and is a great center of winter sports; it is consequently much frequented by English and other nationalities who enjoy the sports of skating. curling, tobogganing, ski-ing, bandy, etc., which can here be obtained under

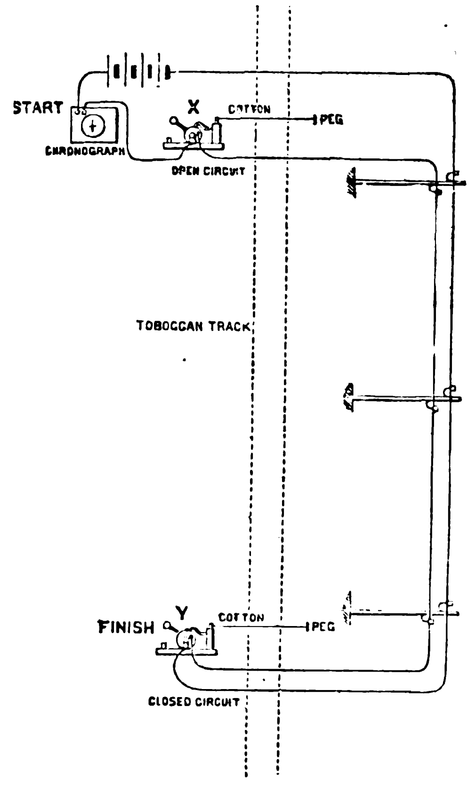


Fig. 2.

the best conditions. Good tobogganing may be had in other places, but at St. Moritz it is carried to a fine art, and only an expert can expect to compete successfully on the renowned "Cresta" toboggan run, with its wonderful curves and banks. The name Cresta is derived from a small village of that name near the finish of the course.

Fig. 1. gives a rough outline of the course, which is a little over three-quarters of a mile in length, with a difference of elevation from the start to finish of about 600 feet; the gradient varies at different points, being most steep at the church leap.

As only one toboggan can occupy the track at a time, the races are all decided by the time taken to complete the course. The record time from the start to the finish is at present $61\frac{6}{10}$ seconds, this entailing a speed of 60 miles an hour or more on the fastest parts. The curves of frozen snow are built up with high banks accurately shaped to allow the tobogganer to go round them at the greatest speed, the highest bank being about 25 feet in height. These different banks have well-known names, such as the Battledore and Shuttlecock, Scylla and Charybdis, Bulpett's Corner, etc. The whole track is practically of ice, and after passing the finish it has for a short distance a steep upward gradient, the great momentum obtained carrying the tobogganer up hill.

The toboggans used are of the "skeleton" pattern with steel runners, the tobogganer lying in a prone position and steering with his feet, by means of spikes attached to the toes of his boots. The principal race run on the Cresta is the "Grand National," which takes place at the end of February, or beginning of March, and might be called the "Derby" of tobogganing, competitors coming from Davos and other places to take part in this contest.

At the side of the course there are poles carrying four overhead wires on ordinary porcelain insulators; the two upper wires are connected to a telephone at each end to allow of communication between the officials in charge of the starting and finishing points. The two lower wires are connected to the timing apparatus, which is arranged as in Fig. 2.

At the starting point, one overhead wire is connected through a battery of 10 cells to one terminal of the chronograph, the other terminal being connected through the trigger switch X to the other overhead wire. The further ends of the overhead lines are connected at the finishing points to another trigger switch Y.

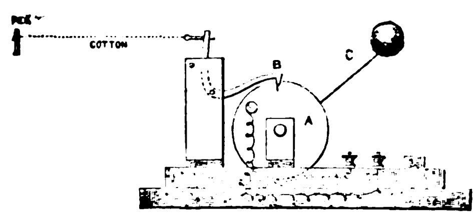


Fig. 3.
Switch with Trigger Set and Attached to Cotton.

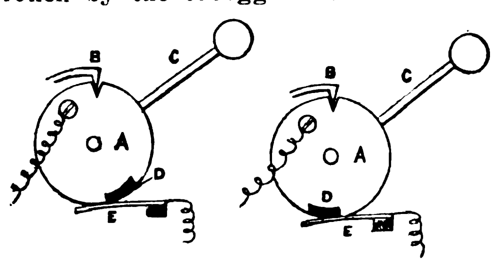
Both switches X and Y are firmly fixed at the side of the course, and have each a strong cotton line attached, with one end to the trigger of the switch; the line is stretched across the track about $2\frac{1}{2}$ inches from the ground, and the other end is tied to a peg driven into the ground on the further side.

The switches X and Y are nearly identical, and are represented in Fig. 3. A circular wheel of brass, A, is mounted on bearings and has a notch in its periphery in which the pawl B is placed when the trigger is set. To the wheel is fixed a radial arm, C, with heavy brass bob, which falls by gravity when the pawl is disengaged by the cotton being pulled. At the lower edge of the wheel, A, a piece of ebonite, D, is inserted in slightly different positions in the two switches (Fig. 4); also a metallic spring contact, E, is pressed against the under side of the edge of A.

As will be seen in Fig. 4, when the

*From the "Electrical Review." London

pawl is set in the notch in the two switches, the spring E in switch X will be pressing against the ebonite, D, and in switch, Y, the spring, E, is making contact with the wheel, A Before the tobogganer starts, both switches are set with the pawls, B, in the notches of the wheel, A, and the cotton stretched from the trigger across the track at start and finishing points. The signal is given and the tobogganer starts from a few yards behind the cotton; his toboggan striking the cotton pulls and breaks it, disengaging the pawl; the arm, C, drops at switch, X, closing the circuit, which allows the current to flow through the electro-magnet of the chronograph, the armature releasing the clockwork, which immediately starts and continues until the cotton attached to switch, Y, is pulled and broken by the toboggan at the finish of



Switch Y Circuit Closed. Switch X Circuit Open.

FIG. 4.

the course, when the arm of switch, Y, falling breaks the circuit and stops the chronograph; the time is then noted, and the apparatus reset for the next tobogganer. The chronograph has a stop for resetting the hand at zero, one complete revolution of the hand representing 30 seconds and these being subdivided into tenths.

It may be mentioned that with the switch at the starting point, the pawl, B, can be arranged so that a comparatively hard pull is required to disengage it, but at the finishing point, owing to the very great speed of the toboggan, the pawl must be arranged so that a light pull will disengage, or otherwise the cotton will break without releasing it.

ELECTRICAL STATION PRACTICE.

ARTICLE XXXIII.

BY W. H. RADCLIFFE.

The testing of the generators in an electrical station necessitates certain resistance measurements being taken among which are those of the armature winding and field winding mentioned in the preceding article. These measurements are best made upon a Wheatstone bridge, and for station work the portable form of this bridge will be found most convenient.

A diagram of a Wheatstone bridge is shown at W in Fig. 33. The current employed is that furnished by a battery, h, usually composed of two cells. The battery, h, together with a key, k, for opening and closing the battery circuit are joined in series with each other and con-

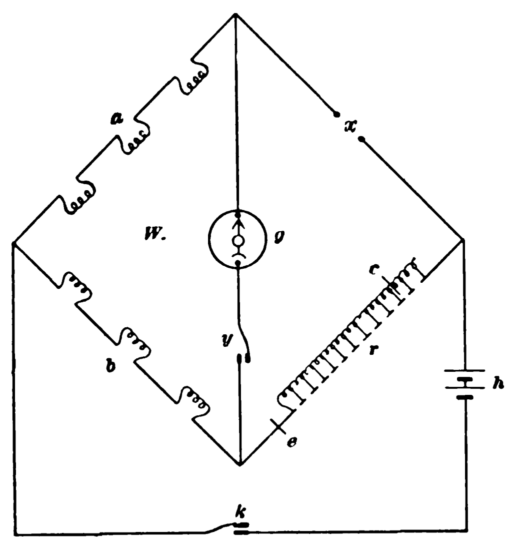


FIG. 33.

nected between the junction of a and b, and the junction of x and r. The parts a, b, x and r are called the arms of the bridge and represent resistances of which the three a, b and r have known values but x is the resistance it is desired to determine. The resistances a and b generally consist of three coils of 10, 100, and 1,000 ohms each and are known as the ratio arms of the bridge. The resistance, r, consists usually of about 16 coils ranging in value from 1 ohm to 4,000 ohms and is known as the adjustable resistance arm of the bridge. The resistance of each coil is, in every bridge, stamped immediately above the coil on the top of the bridge in full view of the tester. A galvanometer, g, and a key, y, for opening and closing the galvanometer circuit are joined in series between the junction of a and x, and the junction of b and r. In practice it is convenient to have the keys y and k close together so that they may be operated with the same hand. It is, however, advisable to close the battery key first, in order that the current through the arms of the bridge may become steady before the galvanometer is brought into circuit. This is particularly necessary when measuring the resistances of field magnet coils on account of the high inductance of the windings.

The resistance coils are formed of insulated german-silver wire and are wound non-inductively, that is, the wire is doubled before being coiled up, so that the magnetic field caused by one-half of the coil will be neutralized by the effect of the other half and thus exert no influence on the galvanometer. The resistance coils are brought into circuit at will by means of brass plugs, which when withdrawn from between the brass blocks to which the resistance coils are soldered, cause them to form a part of the arms of the bridge. Before commencing a test, it is necessary to have all the plugs in the respective holes short-circuiting the resistance coils. The plugs should fit firmly in position so as to reduce any error occurring in the measurements from contact resistances; for the same reason it is best to take advantage of the double terminals usually provided on the binding screws, by placing but one wire in each of the terminals. Another point worthy of mention is that of placing the wire to be connected, on that side of the screw so that when the binding nut is screwed down upon it, it will tend to draw the wire rather than push it; by so doing there will be less danger of the connection working loose and introducing undesirable resistance. It must also be remembered that a good electrical connection can be secured only when the contact surfaces are clean; it is therefore advisable to scrape the wires with a knife or with fine sandpaper before connecting them, and occasionally to clean the binding screws on the bridge.

The method of using the bridge for the measurement of resistance after being connected, as in Fig. 33, is as follows: The resistance whose value it is desired to determine is joined in circuit at x, and a certain known resistance, 100 ohms for example, is unplugged or introduced in each of the ratio arms a and b. In the arm, r, a resistance is unplugged which is as nearly equal in value to the unknown resistance x as can be guessed. The key, k, is then closed, following which the key y, is also closed. There should then be a deflection of the pointer in the galvanometer, g, and the direction of this deflection should be noted. If the value of the known resistance r introduced is too high the deflection will be in one direction, and if its value be too low the deflection will be in the opposite direction; a means is thus provided to guide one in determining the amount of resistance to introduce in r for any given case, the object being to so adjust it that there will be no deflection of the galvanometer pointer when both battery and galvanometer circuits are closed. When there is no deflection under the conditions mentioned, the arms of the bridge are said to be balanced, and the resistance x is then equal to the ratio of the resistances a to b multiplied by the resistance r, all resistances being expressed in

ohms. Expressed in a formula this becomes

$$x = \frac{a}{b} r.$$

When the resistance x is known to be low, as in the case of an armature winding, and it is desired to measure it within a fraction of an ohm unequal resistances should be used in the two ratio arms, that in the arm a being made the lower; on the other hand when the resistance x is known to be high, as in the case of insulation, the resistances in the ratio arms should also be made unequal but that in the arm a must be the higher. If a copy be made of the table here given which shows the best resistances to use in the ratio arms of the bridge for measuring different values in the x arm, and the copy be pasted on the bridge, no confusion need exist in making the various tests if some approximate idea be had of the unknown resistance. The values given in the table are intended for a bridge having a total adjustable resistance r of 1,110 ohms. If, however, the arm r has ten times this resistance then values of x ten times greater than those given in the table can be measured without altering the resistances in the ratio arms. The table is as follows:

Approximate value of x.	Resistance in a-arm.	Resistance in b-arm.
10 ohms or less.	1,000 ohms.	10 ohms.
110 " "	1,000 "	100 "
1,100 " "	1,000 "	1,000 "
11,000 " "	100 "	1,000 "
111,000 " "	10 "	1,000 "

In the operation of the Wheatstone bridge there are certain rules to be followed in addition to those already given, if the best results are to be obtained with the minimum amount of trouble. In Wheatstone bridges of standard form there will be found openings in the arm r at c and e which are marked inf. (infinite); under ordinary conditions these openings are bridged by brass plugs so that the circuit through them is normally closed. If the amount of resistance in the arm r is not found sufficient for making a given measurement, the plug at e is withdrawn and another box of resistance coils are connected to the binding posts provided on each side of the plug e. The test is then made in the same manner as before, the amount of additional resistance employed being of course taken into account in the value of r. In case the unknown resistance inserted at x is open-circuited, the plug at c becomes useful, for then a balance of the four arms of the bridge can only be obtained by removing this plug. Such being the case, the cause thereof is at once known. At times when the bridge is used merely as an adjustable resistance, the arm r only is employed, and these plugs may then be found useful as keys for connection and disconnection. In operating the galvanometer key it is advisable to tap it lightly until a balance is nearly obtained, else the galvanometer may be subjected to a strong current which will cause its needle to be deflected unnecessarily, and if the instrument is sensitive considerable time will be wasted in waiting for it to settle at rest. In addition to this, the needle is liable to be bent, and the resistance coils will become more or less heated, thereby increasing their resistance and introducing an error in the results if the current be left on too long or it be unnecessarily strong.

Measurements of insulation resistance may be made on the Wheatstone bridge in the manner previously described if the bridge be connected as in Fig. 33 and the insulation resistance be introduced in the x arm. Insulation resistances up 111,000 ohms may be measured on a Wheatstone bridge having in the arm r an adjustable resistance of 1,110 ohms, and insulation resistances up to 1,111,000 ohms may be measured if the adjustable resistance be 11,110 ohms. Beyond the value of 1,000,000 ohms or 1 megohm, however, it is usual to employ the equal deflection method for measuring insulation resistance.

The equal deflection method consists in comparing the galvanometer deflection produced by a current which passes through a known resistance with the deflection produced by the same current when passed through the unknown insulation resistance. The value of the latter is then equal to that of the known resistance multiplied by the ratio of the former deflection to the latter deflection. In making insulation resistance tests on generators, one of the lead wires should be connected to the armature or the field conductors as the case may be, and the other lead wire to the iron frame of the generator. In case the value of the insulation resistance between the armature winding and the field winding is desired, the two lead wires should be connected to these respective conductors. Care must be taken during the test that there be no other connections between the parts tested, and it is best to switch on the testing current about one minute before taking a measurement in order that the parts become well saturated. The testing current should be supplied at a pressure between 50 and 100 volts, and a shunt must be employed to vary the sensibility of the galvanometer. The galvanometer should preferably be of the D'Arsonval type, and the known resistance employed should have practically the same value as that of the insulation resistance undergoing test.

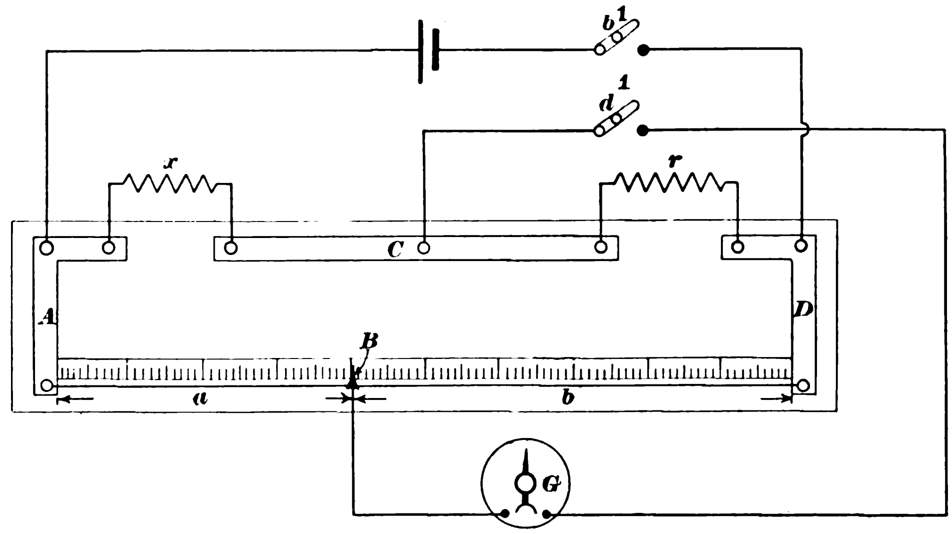


FIG. 34.

The ordinary magneto bell is sometimes used in a station to test the insulation of a machine. It is, however, a rough method at best only showing whether or not the insulation is up to a certain standard, which standard is that through which the magneto is designed to ring. This is usually between 10,000 and 30,000 ohms, so if the magneto be connected with one terminal to the winding of the generator, the other terminal to its frame, and the handle of the magneto rapidly revolved, it will be known if the bell rings that the insulation resistance is less than that amount; on the other hand if the bell does not ring, it will be known that the insulation resistance is greater than that amount. Inasmuch as the insulation resistance of a generator must usually be considerably greater than the figures previously mentioned, the magneto bell is seldom of much value in tests of this nature; it is, however, very convenient in testing the continuity of the circuit, that is, in ascertaining whether or not a cir-

cuit is complete. If it is complete, the bell will of course ring when the magneto is operated upon it, otherwise it will not. If a magneto bell be not at hand, a battery cell and an ordinary electric call bell may be used instead for testing the continuity of a circuit.

In addition to a resistance test of the insulation used on a generator, it should also be given a high potential test before the generator is placed in commission. For this purpose an alternating current of at least double the rated voltage of the generator should be used, the pressure being applied in succession between the armature winding and frame, between the field winding and frame, and between the shunt and series field windings. By means of an electrostatic voltmeter connected in the testing circuit, it is possible to measure the voltage applied and also to ascertain whether or not the insulation breaks down or becomes punctured thereby. If it does, the weak spot can usually be detected by a buzzing sound caused by the passage of a spark, and the defect must of course be remedied before the machine is put into service.

For the measurement of smaller resistances than those we have been considering, such for example as the resistance of contact between the brushes and commutator of a generator, which may perhaps be but a few hundredths or thousandths of an ohm, the slide wire bridge shown at A C D in Fig. 34 should be used. The bridge itself consists of three copper strips A, C and D, so arranged as to permit of the unknown resistance x being connected between A and C, and a known resistance r of approximately the same value as x being connected between C and D. Between the copper strips A and D, and resting upon a graduated scale, is stretched a german-silver or platinum-silver wire of considerable resistance so that there will be an appreciable fall of potential along it. Upon this wire slides a carriage B carrying some form of index for reading its position on the graduated scale. The carriage is joined in series with a low resistance, reflecting galvanometer G (provided with lamp, scale, and shunt) and a key d^1, and is electrically connected with the strip C. The current used in the test is obtained from a battery connected through a key b^1 to the strips A and D.

A comparison of the Wheatstone bridge in Fig. 33 with the slide wire bridge in Fig. 34 will show that the latter is but a modification of the former, and to render the comparison less difficult the corresponding resistance arms of the two bridges are lettered the same. The only difference here is that instead of varying the known resistance r, this resistance is maintained constant, and the resistances in the ratio arms a and b are varied by moving the carriage B along the silver wire beneath it until a balance is obtained; that is, by adding resistance to one of the ratio arms and subtracting it from the other ratio arm, a point is finally reached where no deflection occurs in the galvanometer G upon closing the battery and the galvanometer circuits. Under these conditions the unknown resistance

$$x = \frac{a}{b} r.$$

In this formula, r equals the value of the unknown resistance, and a and b are the respective distances as measured on the graduated scale between the index on the carriage B and the copper strips A and D. Theoretically, a represents the resistance of the silver wire between B and A, and b the resistance of the silver wire between B and D, but since the wire is of uniform area and composition its resistance is uniform, and so the ratio of the resistances is equal to the ratio of the lengths. In practice, the scale is graduated into 1,000 equal parts and it being therefore easy to read the lengths a and b, they are always used in preference to the corresponding resistances.

As in testing with the Wheatstone bridge, the key b^1 in the battery circuit of the slide wire bridge should be closed a few seconds before the key d^1 in the galvanometer circuit, for the reason previously stated. It is also necessary where particularly accurate results are desired, to interchange the positions on the bridge of the known and unknown resistances and take a second reading of the index on the carriage; the two values found for x should then be averaged. The result thus obtained will be practically free from errors due to the introduction of contact resistances at the extremities of the silver wire. In tests meriting the elimination of contact resistances, the position of the galvanometer should be considered; it should be placed at such a distance from the resistance coils that any magnetic effect developed by the latter will not influence the deflection in the galvanometer. A convenient method of testing for such a disturbance consists in disconnecting the galvanometer leads and watching for a deflection when the testing current is alternately applied to the rest of the apparatus.

The proper time for measuring armature or field resistances is immediately after shutting down the generator from a full load run, for then these windings are warm and consequently of a higher resistance than when they are cold. The results obtained at that time will therefore represent the actual working values which are usually those most desirable to obtain.

ELECTROLYTIC SEPARATION OF METALS.

(From our London Correspondent.)

Mr. M. Hollard contributed to the February meeting of the Faraday Society (London) a paper on "Some Applications of the Theory of Electrolysis to the Separation of Metals from One Another." He explained that the only principle hitherto involved in electrolytic separation has been based on the method of successive potentials, each metal depositing at the potential proper to that metal. In practice this principle has only been applied to metals (copper and silver, silver and bismuth, mercury and bismuth) whose polarization potentials are lower than that of hydrogen. Metals whose polarization potentials are higher, cannot be separated by gradual increase of the EMF. on account of the extremely small fraction of the current then used to precipitate the metal, hydrogen ions carrying most of current. Mr. Hollard therefore made use of three other applications of the theory of electrolysis as follows:

I.—Reduction of the Resistance of the Bath by Suppressing the Formation of the Gas at the Anode.—The current may thus be increased in two ways. (1) By suppressing the liberation of oxygen at the anode. To effect this a reducing agent such as sulphurous acid may be introduced. The same potential will then greatly augment the current and hasten precipitation. The method has been successfully applied to separate nickel from zinc. (2) By the use of soluble anodes. The anode must replace in the solution the metal that is to be separated, and that only, and it must be immersed in the solution of an indifferent salt, a membrane separating the anolyte and catholyte. Obviously an external source of electricity is unnecessary. The nickel zinc separation is again given as an example, the operation being described in detail. In this case there is a limit to the relative quantities of zinc and nickel that can be separated. For by Nernst's formula

$$e = \frac{k}{v} \log \frac{P}{C} - \frac{k}{v} \log \frac{P^1}{C^1}$$

where e is the EMF. between the metals, k a constant for a definite temperature, v and v^1 the valencies, and C and C^1, the

concentrations of the precipitating and precipitated metals. When the concentration C of the zinc in the inner cell increases, e will diminish. There must not, therefore, be too much nickel to deposit. The phenomenon is complicated by secondary reactions which must be taken into account in the cases of other separations, such as concentration EMF.'s, increase of EMF. due to local action, and migration. These were discussed fully in the paper.

II.—Influence of the Nature of the Cathode.—By suitably choosing the metal for the cathode, the liberation of hydrogen may be completely avoided, and the conductivity may be so much increased that the separation of the metals becomes possible. The division of metals into two groups which can and cannot be deposited from strongly acid solution, has for its basis the position occupied by hydrogen in the polarization potentials of the metals. But this, as Caspari has shown, varies with the metal of the cathode. Hence by suitably altering that metal, metals can be made to pass from one group to the other, and thus separations, impossible with a platinum cathode, may be effected. The separation of zinc and cadmium (impossible on a platinum cathode) is given as an example. Platinum gauze, covered electrolytically with tin and cadmium, forms the cathode.

III.—Formation of Complex Salts.—Metals may be prevented from precipitating by causing them to form complex salts, which dissociate to give not the metallic ions, but complex ions containing the metal. As an example, the separation of antimony and tin in a solution of sodium hydrogen and sulphide was described.

A FEW NOTES ON THE STEAM TURBINE.*

BY HON. G. L. PARSONS.

The early turbines were governed by a lantern type of throttle valve worked by the movement of a leather diaphragm, which the suction of a fan on the shaft tended to close against a spring. The admission of air to the diaphragm was controlled by an electrical governor. On the top of the magnet yoke there was a small iron bar pivoted on a vertical spindle and carefully balanced. This was moved round by the alteration of the magnet yoke against a spiral spring. A double finger or arm was keyed on the same vertical spindle; the end of each finger was flat, and when opposite to the inlet of the air-pipe, closed it. The spiral spring was so adjusted by a movable head that the greater the voltage the more was the air inlet closed by one of the fingers. When the inlet was open the air rushed along the pipe and partially neutralized the suction of the fan, allowed the diaphragm to extend, and thus opened the throttle valve. If the dynamo got demagnetized the needle turned the other way, and the safety finger closed the air inlet and thus cut off steam. This type of governor was very sensitive, and kept the voltage steady within 1 per cent. The steam consumption of a 32 kw. plant of this type running non-condensing was about 48 lbs. per electrical horse-power hour with a boiler pressure of 61 lbs., and about 42 lbs. per electrical horse-power hour with a boiler pressure of 92 lbs.

In 1899, owing to temporary loss of patents, the radial-flow type of turbine had to be adopted. This consisted of a series of fixed annular disks with rings of blades, between which another series of disks keyed to a shaft rotated. The guide blades were secured to the faces of the stationary disks, and nearly touched the rotating disks, while the moving blades, nearly touched the fixed disks. The steam passed outwards through the successive rings of blades, then inwards along the back of the first moving disk, and again outwards through the next ring of blades until it finally reached the exhaust. In 1892 this type of turbine was first tried condensing with a vacuum of 27 inches. With slightly superheated steam at a pressure of 100 lbs. the consumption at the normal full load of 100 kw, was 27 lbs. per kilowatt hour.

In 1894, however, the parallel flow-type was again adopted with considerable improvements. The turbine was made single-ended, with the steam passing in one direction only, the second series of rings being replaced by three rotating pistons, or dummies, by which the end pressure of the steam along the shaft was balanced. Each of the pistons corresponded in size to the part of the turbine it balanced, and to which it was connected by a pipe. Grooves were turned in these pistons, between which the corresponding fixed collars of the cylinder projected, and, being almost in contact, reduced the leakage of steam to less than 2 per cent.; the amount of clearance could also be regulated by the thrust bearing at the end of the turbine shaft.

The governor can be of the mechanical type, which keeps the speed constant, or of the electrical solenoid type, which maintains a constant pressure at the terminals of the dynamo by raising the speed of the turbine to meet the fall in voltage due to the increase of the load. The electrical governor is now seldom fitted except on the smaller continuous current plants. A small pump supplies oil under pressure to all the bearings, the oil being then returned to the tank to be used over and over again, resulting in a great saving as compared with reciprocating engines. Inside the cylinder itself no lubrication is required, since no parts are touching; the two end packing glands being of similar construction to the balancing pistons, also run clear, hence no oil can possibly find its way into the exhaust. Turbines are running in breweries and chemical works, where the exhaust is led straight into the vats or liquids which require to be heated, and at Heaton part of the turbine exhaust steam is especially condensed to be used as distilled water for delicate chemical processes. The cost of oil for a large turbine works out at about 0.002d. per kilowatt hour. The single-cylinder type of turbine has again been adopted for the large as well as for the smaller sizes, being found cheaper as well as more efficient, besides requiring a shorter engine room. Plants up to 10,000 I.H.P. are now being constructed with a single cylinder. As a high vacuum is most important for obtaining the best results in steam economy, ample space is allowed at the end of the turbine for the exhaust steam, and the condenser is generally placed in a pit straight under the turbine, so that the drop in vacuum may be as small as possible between the machine and the condenser, while the length of piping required is greatly reduced. The following table shows the effect of variation of vacuum on the consumption of steam in the case of a 1,500 kw. set. For the smaller sizes the variation is not so marked:

Vacuum bar = 30 in. Inches.	Difference in steam consumption per 1 in. of vacuum. Per cent.
29	6
28	5
27	4
26	3½
24	3
22	2¼
16	2

As regards the cost of obtaining these high vacua, a little investigation will show that the extra power required to maintain a higher vacuum in a given condenser (and the cooling surface need not be larger than usual) is very small in comparison with the saving of steam in the main turbine with a good vacuum. Three sets of 300 kw. each have just been completed for the Corporation of Derby. They run at 3,000 revs. per min., and

*Abstract of a paper read before the Newcastle (Eng.) Local Section of the Institution of Electrical Engineers, March 21, 1904.

are intended to supply current for traction and lighting. Curves were taken on a Horn tachograph showing the variation of speed when the main circuit was made and broken on a load of 350 kw. The temporary variation did not exceed $4\frac{1}{2}$ per cent. and the permanent $2\frac{1}{2}$ per cent. The dynamo was tested by throwing 350 kw. off and on when running both as a shunt machine and as a compound, no movement being found necessary for the brushes, which were of brass wire. The following table shows the variation of voltage under different conditions:

	Kilowatts.	Voltage.	Speed.
Compounding in use ..	0	505	3,075
" "	336	565	3,000
Shunt only	300	500	3,000
	0	543	3,075
	0	520	3,000
(Constant excitation)...	0	518	3,000

STEAM TURBINES FOR BOSTON NAVY YARD.

An interesting departure in engineering practice by the authorities of the United States Navy, Department of Yards and Docks, is marked by the introduction of Westinghouse-Parsons steam turbines for furnishing power for lighting the buildings and yards, and power for operating dry dock pumps and miscellaneous machinery.

The initial installation of this character is in process of construction at the Charlestown Navy Yard, Boston, Mass., and for the present one Westinghouse-Parsons turbine generating unit of 750 kw. capacity will be placed in service. This turbine will be of the new short-barreled type and is now under construction at Pittsburg. Worthington surface condensers will be employed, using salt water for circulation. The condensers will be located between the foundations, which consist of concrete piers. A running vacuum of 28 inches will be secured through the aid of a dry air pump. Steam will be furnished at 150 lbs. pressure by Babcock & Wilcox boilers in units of 350 hp., equipped with Roney mechanical stokers. Coil superheaters in the boiler settings will furnish to the turbine a superheat of about 100 degrees F. The boiler house will be equipped with a complete outfit of coal and ash handling machinery.

The present power plant is the outcome of an appropriation made in 1898 by Congress for a dry dock and pumping plant to be located at the Charlestown Navy Yard, the new plans for a dry dock equipment providing for a power plant located near the outer end of the new dock with piping connections to both old and new docks so that the one pumping plant would be able to handle them simultaneously or separately. During the period of construction of the new dock the Department of Yards and Docks at this Navy Yard underwent considerable enlargement necessitating an immediate increase in an electrical generating equipment for supplying light and power to buildings and departments.

In view of this situation, it was decided to supersede the dock pumping plant, originally provided for, by a central lighting, power and heating plant for the entire department, although retaining the dry dock pumping equipment, which will now be electrically driven from the central station. It is also intended to supply from this plant electric light and power to the vessels docking which do not happen to be under steam. The power system as now under construction is, therefore, considerably more comprehensive than originally laid out.

The turbine plant will supply three-phase alternating current at 2,300 volts, this voltage being used for general distribution and for direct use in larger motors, while for lighting, lower voltage will be provided by transformation. The turbine generator will be served by a $37\frac{1}{2}$ kw. compound exciter unit.

AMERICAN STREET RAILWAY ASSOCIATION

We have received the following communication from Secretary Penington:

"The 23d Annual Convention of the American Street Railway Association will be held in Recital Hall, Festival Hall Building, World's Fair Grounds, St. Louis, Mo., Wednesday and Thursday, October 12 and 13. One session each day, 10 A.M. to 1 P.M. The Mechanical and Accountants' Associations will meet the same week at the same place, so all members will have an opportunity of attending all the conventions and visit the exposition at the same time. No exhibits will be displayed by this association this year. The headquarters of the association will be at the Southern Hotel. A limited number of rooms will be reserved for us at the downtown hotels, if applied for before June 1. The rates are as follows: Southern Hotel, $10 to $15 per day per room with bath, American plan; Planters Hotel, $10 per day per room with bath, European plan; Jefferson Hotel, $10 to $15 per day per room with bath, European plan; St. Nicholas Hotel, $7 to $10 per day per room with bath, European plan; Lindell Hotel, $5 per day per room with bath, European plan.

"Rooms can be occupied by three persons if desired at same price, the charge being for the room whether occupied by one, two or three persons. It must be understood to reserve rooms in these hotels, that they must be paid for from October 8 to the end of the convention, two days in advance of convention week, and whatever revenue is received by the hotels for these rooms during the 8th and 9th will be rebated to you.

"Wednesday, October 12, has been set apart as 'Street Railway Day' and special attractions of some kind will be furnished by the exposition authorities. The banquet will be held Thursday evening, October 13.

"Papers will be presented that will interest all members.

"The following resolution was directed to be sent to all members, viz.: 'The secretary is directed to request the chief officers of the different companies to notify delegates and heads of departments attending the convention for the companies they represent that they will be expected to attend each session and take part in the discussion, that hereafter at each session of the convention the roll of delegates will be called at the time meeting is called to order, and that the roll call will be published in the minutes of the meeting.'"

INTERNATIONAL ELECTRICAL CONGRESS.

We are informed that the following papers are promised for Section A—the section on "Theory" of the International Electrical Congress—of which Prof. E. L. Nichols is chairman and Prof. H. T. Barnes secretary:

FOREIGN.

Prof. Paul Drude—"Metallic Conduction."

Prof. W. Jaeger—"Electrical Standards."

Sir Oliver Lodge, F.R.S.—"Ions."

Prof. H. Nagaoka—"Magneto-Striction."

Dr. J. J. Thomson, F. R. S.—Subject to be announced.

Prof. J. S. Townsend, F.R.S.—"The Theory of Ionization by Collision."

Mons. J. Violle—"Secondary Standards of Light."

C. T. R. Wilson, F.R.S.—"Condensation Nuclei."

Prof. P. Zeeman—"Magneto-Optics."

AMERICAN.

Dr. Louis A. Bauer—"The State of Our Knowledge Regarding the Earth's Magnetism."

Dr. Carl Barus—"Atmospheric Nuclei."

Prof. H. T. Barnes—"The Mechanical Equivalent of Heat as Measured by Electrical Means."

Prof. D. B. Brace—"Magneto-Optics."

Prof. H. S. Carhart and G. W. Patterson, Jr., Ph.D.—"The Absolute Value of the Electromotive Force of the Clark and Weston Cells."

Prof. C. D. Child—"The Electric Arc."

Dr. K. E. Guthe—"Coherer Action."

Prof. E. P. Lewis—"Electrical Discharges in Gases."

Prof. L. T. More—"Electrostriction."

Prof. E. F. Nichols—"The Unobtained Wave Lengths between the Longest Thermal and the Shortest Electric Waves yet Measured."

Prof. E. L. Nichols—"Standards of Light."

Harold Pender, Ph. D.—"Magnetic Effect of Moving Charges."

Dr. M. I. Pupin—"Electrical Theory."

Dr. Edward B. Rosa—"Alternating Current Measurements."

Prof. E. Rutherford—"Radioactive Change."

Prof. J. C. McLennan—"Radioactivity of the Atmosphere."

Prof. J. Trowbridge—"Electrical Discharge in Gases."

Prof. A. G. Webster—"Electrical Theory."

It is evident from the above list that a very fine programme has been secured by the officers of Section A.

A meeting of the Congress Committee of Organization is scheduled for April 23, at 1:30 P.M., at the offices of the American Institute of Electrical Engineers, 95 Liberty street, New York City.

Acceptances of membership in the Congress number over 1,300 up to the present time, and 150 papers have been promised in all.

The following societies have all promised to hold conventions in St. Louis during the Congress week, and to hold conventions with one or more sections of the Congress: American Institute of Electrical Engineers, American Physical Society, American Electrochemical Society, American Electro-Therapeutic Association and the International Association of Municipal Electricians.

The British Institution of Electrical Engineers has also arranged to co-operate under some plan, the details of which have not yet been determined.

The following bodies have promised to co-operate by sending delegates: Societe Internationale des Electriciens, National Electric Light Association, Association of Edison Illuminating Companies and various other societies.

American Institute of Electrical Engineers.

The 186th meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West 57th street, Friday, April 22, at 8:15 P. M. The following papers will be presented: "The Mechanical Construction of Revolving Field Alternators," by David B. Rushmore, assistant electrician of Stanley Electric Manufacturing Company, Pittsfield, Mass.; "Contribution to the Theory of the Regulation of Alternators," by H. M. Hobart and Franklin Punga, Electrical Engineers, London, England.

American Electrochemical Society's Officers.

The Electrochemical Society brought its Washington convention to a close by electing the following officers: Prof. Henry S. Carhart, of Michigan, president, C. J. Reed, of Pennsylvania; C. F. Burgess, of Wisconsin, and E. J. Acheson, of Niagara Falls, vice-presidents; and Dr. W. H. Walker, of Boston, Mass.; E. C. Acker, of Niagara Falls, and Edward Weston, of Newark, N. J., managers. P. G. Salom, of Philadelphia, was reelected treasurer.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 12, 1904.

Electric Railways and Appliances.

756,859. Trolley-Catcher. Montgomery H. Johnson, Utica, N. Y. Filed July 15, 1903.

756,870. Electric-Railway Switch. Melbourne A. Marks, Jr., Brookline, Mass. Filed Feb. 4, 1903.

756,957. Electric Safety System for Railways. Jacob Hanna and Charles S. Gilman, Rivera, Cal. Filed May 7, 1902.

756,980. Electric Railway. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company. Filed July 5, 1902.

757,107. Safety Device for Electric-Railway Systems. George Gibbs, New York City. Filed Aug. 26, 1903.

757,125. Electrical Railway Danger-Signal. William E. Karns, Parkers Landing, Pa. Filed Nov. 12, 1903.

757,138. Third Rail for Electric Railways. Patrick T. McGowan, Avoca, Pa. Filed Dec. 22, 1903.

757,264. Electric Railway. Davis J. Cable, Lima, O. Filed March 11, 1903.

757,346. Electric Signal for Railways. William B. Ramsay, Hickory, N. C. Filed May 29, 1903.

Electric Lights and Appliances

756,976. Portable Testing and Comparing Instrument for Electric Incandescent Lamps. Albert McCandlish, George Lane, Bredbury, Eng. Filed June 26, 1903.

757,007. Lamp-Terminal. Howard I. Wood and Ralph C. Robinson, Schenectady, N. Y., assignors to the General Electric Company. Filed July 26, 1902.

757,079. Electric-Arc Lamp. James J. Wood, Fort Wayne, Ind. Filed Sept. 4, 1903.

757,314. Electric-Lamp Guard. Jonas Kaufman, Newcastle, Pa. Filed Aug. 1, 1903.

757,364. Combined Lighting and Alarm Device. John Thorsen, Chicago, Ill. Filed Sept. 24, 1903.

Electrical Machinery and Apparatus

756,846. Electrogoniometer. Alexandre Grammont, Pont de Cherny, France. Filed July 10, 1902.

756,960. Rotary-Coverter System. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Filed July 24, 1899.

756,979. Handle for Rotary Snap Electric Switches. Charles G. Perkins, Hartford, Conn. Filed Oct. 29, 1903.

756,991. Electric Condenser. Matthew O. Troy, Lynn, Mass., assignor to the General Electric Company. Filed July 19, 1902.

757,000. Demand-Meter. Roger S. White, Philadelphia, Pa., assignor to the General Electric Company. Filed Aug. 15, 1903.

757,019. System of Motor Control. Frank L. Butler, Schenectady, N.Y., assignor to the General Electric Company. Filed Sept. 13, 1902.

757,064. Electric Igniter for Gas-Engines. Harry J. Smith, Buffalo, N. Y., assignor to the Alberger Company, same place. Filed Aug. 3, 1901

757,261. Power-Transmission Gear. William O. Brown, Chicago, Ill., assignor to the National Hydrocarbon Car Company, same place. Filed May 2, 1903.

757,302. Electric-Current Regulator. Newton Harrison, New York City, assignor of one-half to William Henry Laird, same place. Filed April 21, 1903.

757,357. Dynamo Brush-Holder. William Slee, St. Louis, Mo. Filed Sept. 8, 1903.

757,379. Frictional Power-Transmitting Device. William O. Worth and John D. Worth, Chicago, Ill. Filed Dec. 30, 1903.

757,394. Means for Variably Operating and Controlling Electric Motors. Rudolf Eickemeyer, Yonkers, N. Y.; Rudolf Eickemeyer, Jr., Carl Eickemeyer and Mary T. Eickemeyer executors of said Rudolf Eickemeyer, deceased. Filed June 2, 1893.

757,405-757,406. Booster Apparatus. Lamar Lyndon, New York City, assignor to the National Battery Company, Jersey City, N. J., and Buffalo, N. Y. Filed Aug. 21, 1902.

Telephones and Telephone Apparatus

756,813. Long Distance Telephone System. Michael Beck, Minneapolis, Minn. Filed Nov. 12, 1900.

756,824. Telephone Selecting Device. Lawrence E. Brock, Celina, O. Filed May 13, 1902.

757,031. Semi-Automatic Telephone Exchange. Ernest A. Faller, New York City, assignor of one-half to James W. Chisholm, same place. Filed July 1, 1903.

757,257. Telephone Receiver Support. James A. Brown, Warren, O. Filed Oct. 8, 1903.

757,340. Telephone Support. Howard H. Oothoudt and William F. Stahl, Toledo, O. Filed Jan. 29, 1904.

Miscellaneous.

756,850. Electrical Wire Station. William E. Hamilton, Columbus, O. Filed June 18, 1903.

756,857. Electrician's Tool. Herbert H. Hutchings, Chester, Pa. Filed June 19, 1903.

756,864. Electric Lock. Jay Livingston, St. Louis, Mo. Filed May 22, 1903.

756,891. Rotary Electric Tube Furnace. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Filed Nov. 21, 1901.

756,935. Perforating Glass Bulbs. William R. Burrows, Newark, N. J., assignor to the General Electric Company. Filed March 19, 1902.

756,937. Synchronizing Device. Nathan E. Church, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 27, 1902.

756,941. Spark Gap for Roentgen-Ray Apparatus. John T. H. Dempster, Schenectady, N. Y., assignor to the General Electric Company. Filed June 18, 1898.

756,954. Magnet Coil Spool. Henry Geisenhoner, Schenetady, N. Y., assignor to the General Electric Company. Filed Sept. 13, 1902.

756,966. Panel Board for Electric Distribution. George H. Jones, Chicago, Ill. Filed Nov. 20, 1903.

757,056. Means for Protecting Electrical Measuring Instruments. Maurice C. Rypinski, Schenectady, N. Y., assignor to the General Electric Company. Filed July 25, 1901.

757,164. Battery Cell. Emerson Whitman, Lynn, Mass. Filed July 2, 1903.

757,210. Apparatus for Making Grids for Secondary Battery Plates. Albert F. Madden, Newark, N. J., assignor, by mesne assignments, to the Electric Storage Battery Company, Philadelphia, Pa. Filed April 11, 1903.

757,271. Electromechanical Gong. Frederick W. Cole, Newton, Mass., assignor to the United States Fire & Police Telegraph Company, Boston, Mass. Filed Oct. 4, 1902.

757,341. Relay Magnet. William Palmer, Jr., Rincon, N. Mex. Filed June 14, 1902.

757,355. Galvanic Battery. Charles B. Schoenmehl, Waterbury, Conn., assignor to the Waterbury Battery Company. Filed Nov. 22, 1899.

757,388. Lightning Arrester. Garrison Babcock, Chicago, Ill. Filed Sept. 20, 1902.

757,396. Storage Battery Grid. George W. Frost, Columbus, O. Filed Feb. 9, 1904.

757,422. Dry Battery. Alfred F. Swan, Bayonne, N. J., and Allen W. Rose, New York City, assignors of one-half to the Patent Development Company of America. Filed July 22, 1903.

THE TELEPHONE WORLD.

Eastern New York Independent Companies United.

The Saratoga Telegraph & Telephone Company has consolidated with the Rensselaer Telephone & Telegraph Company of Troy and the Union Telephone Company of Glens Falls. The three systems are to be acquired by the Commercial Union Telephone Company.

New Company for Colorado.

The Wray Telephone Company of Colorado will endeavor to establish telephone communication between Lincoln, Omaha, Neb., and Denver, by means of affiliation with the Colorado Telephone Company and the Nebraska Telephone Company. The intention, as announced by M. H. Spere, a director of the Wray Company, is to build a line connecting Brush, Col., with Culbertson, Neb. The company already has a connection with the Colorado company at Brush, and an arrangement for exchange of business. A similar contract will be asked of the Nebraska company. This will connect Denver and other Colorado towns with the rest of the world as by means of the Lincoln and Omaha connection with Kansas City and Chicago it will be possible to talk to Atlantic coast towns. The company already has several exchanges in operation in Nebraska.

The Automatic Electric Company of Chicago, has installed an experimental set of telephone instruments at Greensboro, N. C., which are working with wonderful precision and alertness, without the presence of any one at all at "central." The connection is automatic, instaneous, and if the line is busy, the fact is indicated by an immediate "buzz" from the machinery at central. The citizens' committee, who have in charge the investigations into the establishment of an Independent system in Greensboro is making a very careful examination of this new improvement in the telephone world, and unless the present friction or war with the Bell Company is adjusted soon the automatic service will be used in the new system.

The Home Telephone Company of Lead, S. D., which has recently taken over the property and property rights of the old Harrison Telephone Company, has three crews in the field repairing and improving its system. The lines connecting Lead with adjoining towns and communities are receiving new poles and wires, and new plants are to be introduced in Lead and Deadwood for the central stations.

The telephone line connecting Hiattville, Kan., with Fort Scott, has been completed and is now in operation. The line is about 25 miles long and has connection with Hepler, Godfrey and a large number of farm residences between the towns named.

Work on the new telephone line from Landisburg to Bloomfield, Pa., is progressing, the poles having been placed along the line preparatory to setting and stringing the wire.

Prominent business men of Iowa City, Ia., are interested in a new telephone company, with a capital of $100,000, that has entered the Johnson County field, and an active rate war is expected.

Extension of Independent Telephones in Nebraska.

A force of men in the employ of the Home Telephone Company are working in the extreme southern part of Sarpy County extending that company's line. There are now 450 telephones in operation throughout that vicinity, including the 175 used in Papillion. Many new orders are being filled as fast as possible and by summer there will be 600 telephones in use throughout Sarpy County. The business is steadily increasing. Arrangements have been made for long distance connection and patrons of the Home Telephone Company are given Lincoln service.

At the recent annual meeting of the Ithaca, N. Y., Telephone Company the directors elected as officers: B. G. Hubbell, president; M. VanCleef, vice-president; H. C. Hinckley, treasurer; Judge Charles H. Blood, secretary. The executive committee is composed of Charles H. Blood, B. G. Hubbell and William T. Morris.

The Potato Belt Telephone Company will operate telephone lines in Anoka, Isanti and Chisago Counties, Minn., with a capital stock of $20,000. Charles E. Burch is president; Roland J. Dyer, vice-president; Marcia A. Mitchell, secretary. With Elmer E. Davis, George L. Sylvester and Samuel F. Cooper, the officers constitute the first board of directors.

The Citizens' Telephone Company in Clinton, Ind., is unable to supply the demand for telephones. Two new lines recently entered that city, and two now are being put up in the western part of the township near Jacksonville, and Scotts.

Owing to the constantly increasing demand of the farmers for telephone connections a new rural line is to run south from Milford, Mich., along the New Hudson road for the accommodation of residents of that vicinity.

The Preble County, O., Telephone Company has been incorporated by John C. Stover, J. E. Flora, A. M. Fudge, J. S. Steward and others. Its capital stock is $25,000.

The Medora telephone line is to be extended from Medora to Inman, Kan., a distance of eight miles, giving Inman its first Independent telephone service.

The Allen County, Ky., Home Telephone Company, with a capital of $2,500, filed articles of incorporation in the office of the Secretary of State a short time ago.

A new concern, known as the Eau Galle, Wis., Telephone Company, has been incorporated by C. G. Billings, William Stoops and F H. Thines.

In March the Chicago Telephone Company installed 1,580 new telephones, making the number in service 105,948.

The Lebanon Telephone Company is rushing the extension of its line from Whitehouse to North Branch, N. J., as rapidly as possible.

The Northville, Mich., Telephone Company is rushed with orders for new telephones.

Telephone Expansion in Ohio.

The Winona Central Telephone Company has begun the extension of its system to the village of Dungannon, where an exchange will be installed with 40 or 50 telephones to begin with. The main line will be extended from Dungannon to Lisbon, which will give the Winona company two trunk lines to the county seat.

The system at Winona has about 200 instruments in operation at the present time, extending over a wide territory. It has connections with most of the Independent systems in Northern Columbiana County, and with the Columbiana County Telephone system.

Within a short time an additional trunk line will be strung between Winona and Salem, which is badly needed; as the traffic is very heavy between those two places. With two lines to Lisbon and two to Salem the company can give much better service.

The Central Ohio Telephone Company of Centerburg, Knox County, has been incorporated by Charles L. Bishop, T. P. Sylvan, E. E. McGuire, J. E. Litzenburg and G. N. Jackson, and will be operated on $10,000 capital stock. It will operate a telephone exchange in Knox County, and pass through Morrow, Licking and Delaware Counties.

At a recent meeting of the executive committee of the Retail Druggists' Association at Kansas City, Mo., it was decided to make an active canvass among the druggists and physicians to abolish the Bell service and substitute the Home.

At a meeting of the village council of Somerville, O., the Hamilton Home Telephone Company was granted a franchise to construct, maintain and operate a telephone system in Somerville. The lines are now being built from Collinsville to Somerville.

The annual election of the Farmers & Merchants' Telephone Company was lately held at Alma, Neb. R. L. Keester was chosen president and general manager. The gross earnings for the year were $2,100 and there are 250 telephones in operation.

The Cairo, O., Telephone Company has elected officers as follows: President, Harry McKinney; vice-president, F. Haines; secretary, John Boucher; treasurer, J. W. Stigall.

The directors of the Farmers' Telephone Company of Hardin, Ill., have perfected plans to extend the company's line from this place to Meppen.

Telephone Incorporations.

The Pennington Telephone Company, Jersey City, N. J. Capital stock, $5,000. Incorporators: William H. Bogart, Jerry J. Croley, and Jos. F. Harris.

The Egg Harbor City Telephone Company, Egg Harbor City, N. J. Capital stock, $3,000. Incorporators: Lorenz Krein, William G. Stockman, George W. Otto and Charles Oberender.

The Telephone Electric Toll Box Company, Trenton, N. J.—to manufacture telephone boxes and apparatus. Capital stock, $125,000 Incorporators: Charles L. Walton, Romeo B. Hazlett and Eli H. Chandler.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Ashland, O.—The council is contemplating putting the question of electric lighting to a vote of the people soon, instead of specifications being wanted, as stated in the issue of ELECTRICITY of March 30.

Belchertown, Mass.—The Amherst Electric Light Company is looking over the ground here with a view to establishing an electric light plant.

Camp Point, Ill.—W. A. Berrian has under consideration the matter of installing an electric light plant here.

Charleston, Mo.—An electric light plant and ice factory may be erected by L. W. J. Danforth.

Chicago, Ill.—This city has granted a 10-year franchise to the University of Chicago, giving it permission to sell electricity for lighting The franchise gives the university the right to use parts of La Salle street and Fifth avenue. Ten per cent. compensation was required.

Edina, Mo.—Mr. Wilson, owner of the Edina electric light plant, has asked the council to grant him a 10-year franchise. He desires to make some extensive improvements to the plant.

Emporia, Kan.—Frederick Bruggemann, of Denver, Col., will probably ask for an electric light plant franchise.

Fall Creek, Wis.—The proposition to have electric lights here is being discussed.

Fond du Lac, Wis.—The council has accepted the bid of the Citizens' Light, Heat & Power Company of Milwaukee for a franchise for a new electric lighting and power plant.

Glastonbury, Conn.—Plans for the development of a combined electric light and water power plant on Roaring Brook have been nearly completed by the Glastonbury Power Company.

Greensboro, Ga.—A franchise for electric lights was lately granted T. B. Rice, of this place, and R. L. West, of Atlanta, and their associates.

Hailey, Ida.—The electric light plant here has been sold to the Idaho Electric Supply Company, with Leo Cramer as president. New machinery may be installed.

Hazelhurst, Ga.—A stock company is being organized here for an electric light plant and waterworks. The cost for both will not exceed $1,500. The power for the electric lights will probably be furnished by the Hazelhurst Manufacturing Company.

Kenmare, N. D.—A new electric light and power plant is to be erected here soon.

Mason City, Ia.—The citizens have voted for an electric light franchise.

Melvin, Ill.—The village council has granted a 20-year electric light and heating franchise to E. E. Sailor, of Cullom.

Nassau, N.Y.—The Nassau Electric Light & Power Company is in the market for a 3,000 kw. generating set to be installed in its new station at Hempstead Harbor, L. I. C. O. Mailloux, electrical engineeer, of No. 76 William street, New York City, has been retained by the company in a consulting capacity.

New Iberia, La.—The city council is making provision for a system of street lighting.

Ocala, Fla.—Col. W. N. Camp, of this city, has made a proposition to the council for the purchase of the electric light plant and all appurtenances. Col. Camp has a project to utilize the waters of the Withlacoochee River, and agrees to furnish the city with at least 1,000 hp.

O'Fallon, Ill.—The citizens are to vote on the question of purchasing the electric light plant here.

Oklahoma, Okla.—The American Electric Light & Power Company has applied for a franchise to construct an electric light plant.

Ossian, Ia.—The citizens will vote on the proposition to issue $5,000 in bonds for lighting purposes.

Pasco, Wash,—Electric lighting of this town is considered. A dynamo may be installed at the Northern Pacific Company's engine house for that purpose.

Prairie View, Tex.—An electric light and power plant will be installed at the State Normal School here. Address Prof. Brown, College Station.

Sedalia, Mo.—The city council is figuring on submitting a proposition to bond the city for money to operate an electric light plant.

Walden, Col.—An electric light and a water plant will be installed here this summer.

Winfield, Kan.—At a recent city election the people voted in favor of issuing $134,000 bonds for the installation of an electric light plant and waterworks system.

STREET RAILWAYS.

Albion, N. Y.—Machinery tools and material are on hand to commence the work of extending east and west the Albion Electric Railway.

Arcola, Ill.—The Eastern Illinois Traction Company has been granted a 50-year franchise to operate an electric line over certain streets in this city.

Buffalo, Ill.—The Illinois Central Traction Company has been granted the right to extend its line through here.

Charlotte, Mich,—Some time ago E. F. Pangburn and A. J. White, of the Michigan Central Traction Company, were denied a franchise by the old council of this city, in spite of a $1,000 check tendered as a forfeit for alleged "lack of faith" in their ability to finance the road. The new council is quite likely now to give the Michigan Central Traction Company a franchise, in which case the Lansing-Battle Creek Electric Road will be constructed this summer.

Clarion, Ia.—Farmers and business men in general throughout Northwest Iowa are deeply interested in the scheme for an electric railway to the Mississippi River.

Clinton, Ia.—The State Electric Street Railway Company was lately voted a franchise here. The company will spend $150,000 in rebuilding and re-equipping its line.

Decatur, Neb.—The townships of Decatur, Riverside and Silver Creek, will vote on the proposition to issue $20,000 bonds for the construction of an electric railway from Omaha to Sioux City.

Elgin, Ill.—The Elgin-Aurora & Southern Traction Company will build a branch road.

New Castle, Ky.—The Fiscal Court of Henry County and the New Castle council will sell an electric railway franchise on April 26. The applicant is the same company that is now putting in an electric light plant and an ice plant at Eminence. It is proposed to connect the two towns, and probably extend the line to the Kentucky River, possibly to the Ohio at Carrollton.

Niles, Mich.—J. S. McMiceal, of Chicago, has been granted a franchise to build an electric line through the township.

Noblesville, Ind.—The Indiana Union Traction Company will soon begin work on the extension of its line.

Owosso, Mich.—Frank Westcott is interested in a new electric road from Grand Rapids to Ionia.

Patton, Pa.—Promoters of the new trolley line through the north of Cambria County, connecting this place, Hastings, Barnesboro, Spangler and Carrolltown, have given out the information that they have closed a deal which virtually assures the building of the road at an early date.

Pittsburg, Pa.—A large force of men is at work building the new electric road which will connect West View with Bellevue. This line will be finished before summer.

St. Joseph, Mo.—The Maryville & St. Joseph Electric Railway Company has been granted the right of way in this city.

Uniontown, W. Va.—The Elkins Syndicate of West Virginia, which already controls lines in this State, is reported to have decided to build a line from Morgantown to this place.

Wheeling, W. Va.—The Wheeling Traction Company will extend its line from Alexander to Clayville, Pa.

POWER PLANTS.

Elkhart, Ind.—Ex-Congressman C. G. Conn has purchased Gov. Durbin's interest in the Elkhart Power Company, organized by Walter Brown, and which was intended to absorb two local hydraulic companies in which Mr Conn held stock. Mr. Conn is now in control of the entire project, and he proposes to invest $1,000,000 in the electric plant.

Lewiston, Ida.—Francis Jenkins, of Moscow, has just completed a deal with John C. Bender, of this city, for the purchase of Mr. Bender's water right at Elk Creek Falls, about 50 miles from here in the North Fork country. Mr. Jenkins will at once organize a company to develop electric power there to be transmitted through the Patlach and Palouse countries for running the electric railways and light plants.

Virginia City, Nev.—It is reported that O. Bealu will install an electric power plant for the operation of his mill on the Chollar lease croppings.

BIDS WANTED.

Pinckneyville, Ill.—Sealed proposals will be received until May 2 by J. C. Namm, city clerk, Box 106, for the construction of an electric light plant.

Richmond, Ind.—The trustees of Earlham College, of which Joseph J. Mills is president. will receive bids for wiring Lindley Hall, and for a system of wiring for the college grounds.

Traverse City, Mich.—Sealed bids will be received until May 31 for the lighting of the streets and alleys of this city. Address Charles M. Beers, city clerk.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 13⅛@13¼c.; Lake 13¼@13⅜c.; casting, 13@13⅛c.

The Lowell (Mass.) Electric Light Company has declared a dividend of $4 per share, payable May 2.

The Montreal Street Railway Company has signed a contract for new equipment amounting to $300,000.

Redmond, Kerr & Co. of New York will pay the coupons of the St. Joseph Light, Heat & Power Company 5s, due May 1.

The Fox River Light, Heat & Power Company of Elgin, Ill., has purchased the Aurora, Elgin & Chicago Power Company.

President Dolan, of the United Gas Improvement Company, Philadelphia, emphatically denies that his company will absorb the Philadelphia Electric Company.

The directors of the Edison Electric Illuminating Company of Boston have declared a regular quarterly dividend of 2½ per cent. and made the same payable May 2.

According to an officer of the Chicago Union Traction Company earnings for the first half of April were fully 15 per cent. in excess of the same period last year.

The directors of the American Telephone Company unanimously confirmed the action of the finance committee in the recent sale of $20,000,000 three-year 5 per cent. notes.

It is understood that the directors of the Chicago Edison Company have declared the regular quarterly dividend, payable May 1. Books close a week preceding the payment.

Lancaster (Pa.) dispatches state that the Philadelphia, Coatesville and Lancaster Railway has bought the Brandywine Electric Street Railway, and will issue $600,000 bonds to pay for the purchase.

At the meeting of the Marconi Telegram Company in Jersey City on Monday, James W. Pyke, J. P. Cotton, H. H. McClure and G. Marconi were elected directors to serve for the ensuing year.

An order was entered at the Appellate Division of the Supreme Court, New York, fixing the compensation for each member of the Board of Rapid Transit Commissioners at $5,000 for the year 1903.

The Havana (Cuba) Electric Railway Company reports for the calendar year gross earnings $1,061,709, and surplus, after charges, of $30,235, against gross of $864,865 and a deficit, after charges of $21,861, in 1902.

The Appellate Division of the Supreme Court, New York, handed down a decision granting the motion for the appointment of commissioners to investigate and report whether or not the Westchester Rapid Transit system should be constructed and operated.

It was stated positively in Wall street Saturday that the directors of the Allis-Chalmers Company have suspended dividends on the preferred stock, but on Monday E. D. Adams, who owns a controlling interest in the concern, stated that no action had as yet been taken by the directors in regard to the dividend.

A statement has been given to the press that the General Electric Company is in a strong financial position and never again expects to have to wrestle with debts, whatever may be the size of any industrial depression. That is why, it claims, it will sell stock even to take care of such a small matter as the $3,000,000 of debt inherited from the Stanley Electric Company.

ELECTRIOAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Apr. 18
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	142¼
Metropolitan Street Railway	113¾
Metropolitan Securities	78
Ninth Avenue	200
Third Avenue	119
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	46
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	66
Philadelphia Traction	96
Union Traction, $17.50 paid	49⅝
Boston.	
Boston Elevated, full paid	139¼
West End Street, com	92¼
do. do. do. pref	111½
Chicago.	
City Railway	161
North Chicago	87
Union Traction, com	6⅜
do. do. pref	30½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	23
do. do. pref	59
Electric Lead Reduction	⅞
Electric Vehicle, com	6
do. do. pref	9
Westinghouse, com	161
do. pref	194
General Electric	164
Boston.	
Edison Electric Illuminating	237½
General Electric	165
Massachusetts Electric Companies, com	19½
do. do. do. pref	74½
Westinghouse Electric & Mfg., com	78
do. do. do. pref	89
Chicago.	
Chicago Edison	150
National Carbon, com	29¾
do. do. pref	100½
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	59
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	126½
Western Telephone Company	8
New England Telephone Company	126
New York.	
American Telegraph & Cable Company	80¾
Commercial Cable Company	170
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88⅞
Miscellaneous.	
Chicago Telephone Company	118
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	30
Consolidated Car Heating	64
Standard Underground Cable	200

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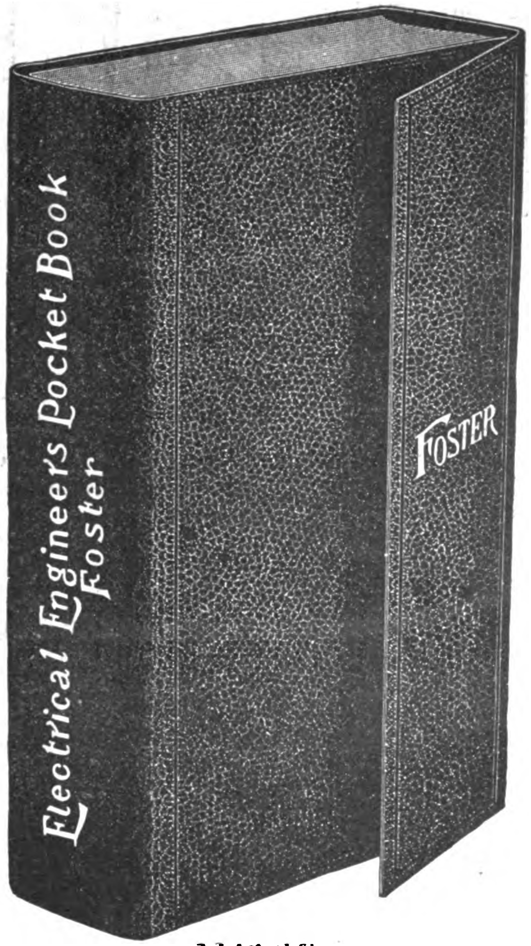

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CONTENTS.

EDITORIAL NOTES.

The Louisiana Purchase Exposition.

Before we go to press again the Louisiana Purchase Exposition in St. Louis will be formally opened by the pressing of an electrical button in Washington by President Roosevelt. The closing of the electric circuit by means of this button at noon on April 30 will set in operation various departments of the exhibition, which commemorates the purchase of Louisiana by the United States from the French in 1803.

As usually happens with most world fairs of this magnitude the date of opening had to be postponed from 1903 to 1904, but if anything the exhibition as a whole will have gained by the enforced delay.

The fair grounds are situated just west of the city and comprise 1,240 acres, of which one-fifth is under cover.

The buildings are multitudinous and of beautiful and original design.

The Palace of Electricity covers an area of about 350,000 square feet and cost approximately $400,000. Here will be located a majority of the electrical attractions, which may be classified into three main groups—electrical exhibits, the generation and transmission of electrical power, and spectacular lighting features.

Exhibits of electrical machinery or apparatus will be in evidence from every prominent nation in the world with one or two exceptions. France, Germany and Great Britain have a very large amount of floor space, but even such countries as Brazil and Mexico will be represented.

There will be a practical demonstration of wireless telegraphy and arrangements will be made for sending messages to various cities.

The illuminating features will surpass anything heretofore attempted and the largest searchlight in the world, rated at 6,000,000 candle-power, will flash from the top of a building near the grounds.

Arrangements have wisely been made for holding a number of congresses at St. Louis during the Exposition. The most important to the electrical fraternity will be the meeting of the International Electrical Congress, which will be held between September 12 and 17. At this gathering there will be present prominent scientists and electrical engineers from almost every civilized country of the globe, who will be prepared to discuss subjects of vital importance to the welfare of the world in general and to the electrical industry in particular

Space will not permit of enumerating all of the electrical features of the Exposition, and as in the case of world's fairs in the past it will be necessary to go there to appreciate them.

* * *

A Protest Against Wireless Telegraphy.

The stand taken by Russia with regard to the use of wireless telegraphy within what may be termed the war zone in the far East opens up a question which will in all probability ultimately lead to an international conference. The text of the communication from the Russian Government to the State Department and which was sent to all foreign offices is as follows:

"In a case in which neutral steamers having on board correspondents who might communicate war news to the enemy by means of perfected apparatus not being yet foreseen by existing conventions would be arrested near the coast of Kuantong or in the zone of operations of the Russian fleet, the correspondents will be looked upon as spies and the steamers

furnished with wireless telegraphy seized as prizes of war."

This order, it is alleged, is aimed at a newspaper dispatch boat equipped with wireless apparatus and with American operators aboard.

The right of the Russian authorities to prevent the sending of wireless news which might be caught by Japanese ships is not questioned, but the declaration that newspaper correspondents will be regarded as spies is to say the least drastic.

At a recent meeting of the Cabinet in Washington the opinion was expressed that it would be desirable, if not indeed absolutely necessary, for this Government to control, at least in a supervisory way, the operation of wireless telegraphy, particularly along the coast. Stations for the receipt of wireless messages are springing up at various places along both the Atlantic and Pacific coasts. It was pointed out that in the event of war with a foreign nation it might be necessary in defense of the nation for officers of the United States to have charge of these stations as a means of assurance to the government that no communication was established with vessels of the enemy's fleet and that the system was not employed to the detriment of the interests of the United States.

Thus far wireless telegraphy has not figured in international affairs, and no conventions covering its use have been considered. It is believed that sooner or later the subject will be taken up by diplomats with a view of reaching an international agreement. What that agreement will be cannot be foretold, of course; but in the meantime it is the opinion of officials of this Government that measures should be adopted to protect the Government against such employment of the wireless system as might be injurious to the nation.

It is stated on good authority that so far as Russia's protest goes no action will be taken by the State Department, unless some specific case involving an American citizen occurs.

* * *

Electric Trains Stop Running. The Liverpool & Southport Electric Railway in England, which was described and illustrated recently in ELECTRICITY, commenced running its trains for the public, according to our London correspondent, on April 5. On April 11, however, operations were obliged to be suspended because a serious subsidence of the generating station had occurred. The electric trains are now idle, and steam trains have had to be reintroduced. The sandy nature of the subsoil is responsible for the subsidence, and it is evident that adequate provision had not been made against such a disaster. It is quite uncertain when the electric trains will again be run.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Richard H. Pierce, of Boston, has been appointed chief engineer for the power plant at the World's Fair. He was consulting engineer at the Columbian Exposition.

Electric automobiles, a special cable dispatch from Paris states, are running petroleum driven vehicles hard.

Governor Odell will give a hearing at the Executive Mansion in Albany at 10 A.M. to-morrow (Thursday) on the Niagara, Lockport and Ontario Power Company bill.

The Buenos Ayres Grand National Tramways Company, Ltd., is to convert its horse car system to electric traction at an estimated cost of $4,000,000. A large portion of the equipment will be bought in the United States.

It is understood that the annual report of the General Electric Company, covering the year ended January 31, is in the hands of the printers. It is stated that the earnings for the year, after the usual drastic writing off of plant and machinery, will be equal to 25 per cent. on the capital stock.

Messrs. Siemens & Halske, of Berlin, according to the London *Electrical Engineer*, have recently patented a telephone which is intended for use exclusively in situations where cross-connections may occur between the telephone conductors and high-tension circuits. The feature of the instrument is that there are no metal parts outside the case which can be touched.

A German technical paper, discoursing on the turbine, of which we hear and expect so much in these days, reminds its readers that it is by no means an idea new in mechanics. Twenty-seven hundred years ago, in the little nation of the Chaldees, adjoining Armenia, the water turbine was known, and built, and used in milling. It was then called the "shell wheel." The wheel was used in a horizontal position, no effort being made to secure the greater value of the water pressure. The wheel was connected to a vertical shaft which turned the stone and ground the grain into a coarse flour. Near the city of Van, believed to have been built 2,000 years B.C., there still remains canals in a good state of preservation. One of them, 60 miles long, is now used for irrigation and power. At one time, centuries ago, there were 40 mills on this canal, and to-day the remains of these ancient institutions may be seen. Flour mills, driven by these simple turbines, of the same type as was used there 2,700 years ago, are still in operation.

Prof. C. F. Burgess and Carl Hambouchin, of the College of Engineering of the University of Wisconsin, it is claimed, have discovered a method of making pure iron at a small cost. By the new discovery, which is the result of three years of research, the product can be made for one cent a pound. The process is similar to that used in refining copper, an electric current taking the impure iron from the plate and depositing it in a pure state on another plate. The pure iron has properties not possessed by ordinary iron or steel. On account of its electrical properties it is a valuable material for the construction of electrical apparatus, and it furnishes the means for making special steel alloys of great strength and hardness.

The question of working the various Alpine tunnels by electricity is being seriously discussed in Switzerland. The Erstfeld-Bellinzona section has been used as an experiment, and the results obtained promise so great an economy in the working of the whole of the St. Gothard line that the adoption of electric traction may be expected at no distant date. The question of electric traction for the Simplon Tunnel is also being raised.

The U. S. Government will exhibit at the St. Louis Exposition specimens of every known radio-active substance, radium compounds, and much other material on the subject.

Three hundred and twenty acres of land near Baker City, Oregon, are soon to be irrigated by means of electricity. The land is too high up on the bench to divert water from the river. There is an abundance of water flowing underneath this land at a depth of about 20 feet. Experiments made last season demonstrated that this source of supply was constant and abundant. There is an electric transmission line which conveys electric power to one of the mines which passes over this land. Arrangements have been made to put in electric pumps to pump water from large wells. A 5 hp. motor will drive a pump that will raise 320 gallons of water per minute, which is sufficient for 80 acres of land.

SINGLE-PHASE ALTERNATING CURRENT RAILWAYS.

BY FRANK C. PERKINS.

The advantages to be gained by the use of a single-phase electric railway system, with a successful motor of this type, are many, and quite a number of prominent engineers have been solving this problem and are working on this line both in this country and abroad. By this railway system the sub-station with its rotary converters is eliminated and the transformers are only of the stationary type, if used at all, as the high tension transmission voltage may be used directly on the trolley line, which consists of a single working conductor. In case extremely high voltages are employed for transmission of power great distances, at from 30,000 to 60,000 volts, the static step-down transformers are simple and do not involve rotary machines at the sub-stations.

With the single-phase high tension railway system it is possible to work on long trunk line railways, current being supplied from hydro-electric plants and steam plants located favorably at coal mines or near a supply of natural gas even at considerable distances from the railways. The advantage of the single-phase system over the polyphase system, should a highly efficient and satisfactory motor of the former type be developed for traction work, would be that a single conductor only would be required as in the direct current system, while the polyphase railway requires at least two above the track with the rails as a third conductor, or, as on the Berlin-Zossen road, three overhead conductors at the side of the track.

A patent was granted to Charles Zipernowsky of Buda-Pest, Austria-Hungary, by the United States in 1893 for a system of supplying current to railways, the intention being to supply an extended area with suitable current in an economical manner. According to these designs a single-phase current is employed for the transmission of the power at high tension and alternating current motors, and direct current generators are employed similar to the polyphase direct current railway systems now so largely employed in this country and abroad. The direct current machines supply a continuous current to the working railway conductors. As direct current motors are employed on the electric locomotive or motor car this can hardly be called a single-phase railway system although alternating currents of this character are evidently used for transmitting the power from the central station as only two conductors are indicated. In reference to this system Mr. Zipernowsky says: "To advantageously conduct electrical energy to great distances it is necessary, as is well known, to use high tensions, and this requirement is for practical reasons only to be met by the use of the alternating current. In the production of continuous currents it is difficult or even impossible to produce such high tensions as, for instance, 10,000 volts or over, while on the other hand such tensions, as is well known, are practically applicable with alternating currents. Alternating currents of high tension and conducted to great distances are conveniently transformed afterward at the places of consumption into currents of any desired tension."

Mr. C. J. Vandepoele was granted a patent in 1890 for an alternating current railways system using static transformers upon the locomotive or train. These transformers were intended to be used for reducing the potential of the current which is collected from the working conductors at high pressure, the current of low tension from the transformers being conducted to the alternating current motors on the car.

Alternating current systems have also been patented by George Westinghouse and C. F. Scott, reducing the leakage under normal circumstances, with automatic devices for supplying full current to the working conductors when the train is passing along a given section of the line. The patent drawings show an automatic alternating current railway system providing means for closing the primary circuits of the transformers as the trains pass. S. Z. De Ferranti and Carl Coerper have patents for obviating the loss due to the primary circuits of the transformers being normally closed along the entire length of the railway line.

A single-phase alternating current system has been proposed by Mordey and Jenkin in England, using the Ward-Leonard method of speed regulation. They propose employing an induction motor driving a direct current dynamo, whose voltage may be varied as desired by the field rheostat while operating at constant speed, and supplying the direct current to the railway motors at low voltage, giving a very heavy starting torque with the use of very little power. This scheme involves the use of a motor-generator set on the train operated at constant speed from the single-phase high tension line, which is connected directly to the motor terminals. By this means all starting resistances are avoided and the speed of the motors may be regulated entirely by means of the field rheostat of the generator of the motor-generator set.

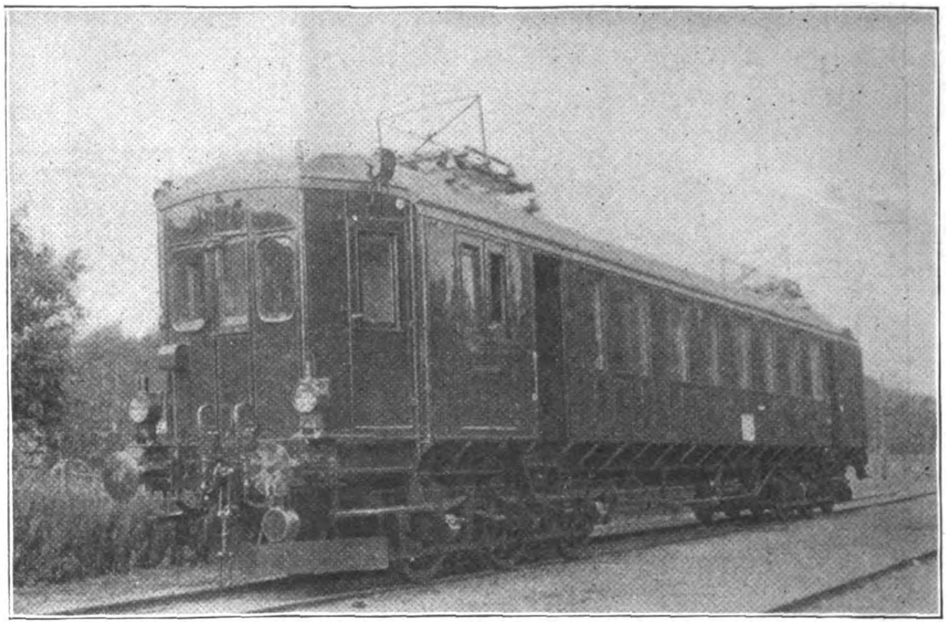

Fig. 1.—Electric Car on Single-Phase Line.

A new German single-phase high tension railway system is being tried on the branch of the German State Railways between Johannisthal, Spindlersfeld and Niederschoneweide, located not far from Berlin. The accompanying illustrations, Figs. 1 and 2, show the track construction as well as the overhead construction, a single trolley wire only being necessary from which to collect the required power. The single-phase alternating current employed has a frequency of 25 cycles per second and is conducted to the car motors at 6,000 volts directly from the overhead trolley wire. This wire is suspended in places by two parallel steel wires and connected by cross wires at short intervals, and in other places by a single steel wire

above the working conductor, the former acting as feeders to a certain extent, as they are not insulated from the trolley wire but are all carefully insulated from the ground.

The current is conducted to the motors on the cars by a couple of sliding bows, one at each end of the locomotive or motor car, and the doors leading to the high tension apparatus are so arranged that they cannot be opened as long as the collecting bows are in contact with the high tension trolley wire. This precludes any possibility of an accident by carelessness on the part of the attendant, as the door can only be opened after taking off the collectors, the latter remaining off until the door is again closed.

The single-phase electric motor which makes this high tension railway possible between Spindlersfeld and Niederschoneweide, was designed by Winter and Eichberg and was constructed by the Union Elektricitats Gesellschaft of Berlin, Germany. It is claimed that no energy is wasted by external resistances in the regulation of speed of this motor and it is possible to wind the motor for very high voltages directly applied. The gear ratio used is 1 : 4.26 and the wheel diameter is one meter, while each of the two motors which are of the four-pole type has a capacity of 125 hp. The electrical equipment weighs somewhat over six tons while the total weight of the locomotive or motor car is about 60 tons, the latter carrying about 50 passengers of first and second class. The trains will include two locomotive cars, one in front and one in the rear, and several ordinary cars between, with multiple unit control, the speeds not being particularly high, varying above and below 40 km. per hour.

A new single-phase railway motor employed on the Spindlersfeld road and constructed by the Union Electricitats Actien Gesellschaft of Berlin is said to have a comparatively large air gap and yet to have all of the advantageous qualities of the series railway direct current motor, rapidly increasing in speed at small loads and also giving a very satisfactory starting torque. If these claims are found to be justified there is no question but that the single-phase railway will soon be extensively installed not only in Europe but throughout America as well. A number of prominent American railway engineers have been working on the single-phase railway problem and it is stated have been very successful in their efforts. A number of single-phase railways of considerable length can be expected in this country at no distant date if the success reported for this alternating current system is assured.

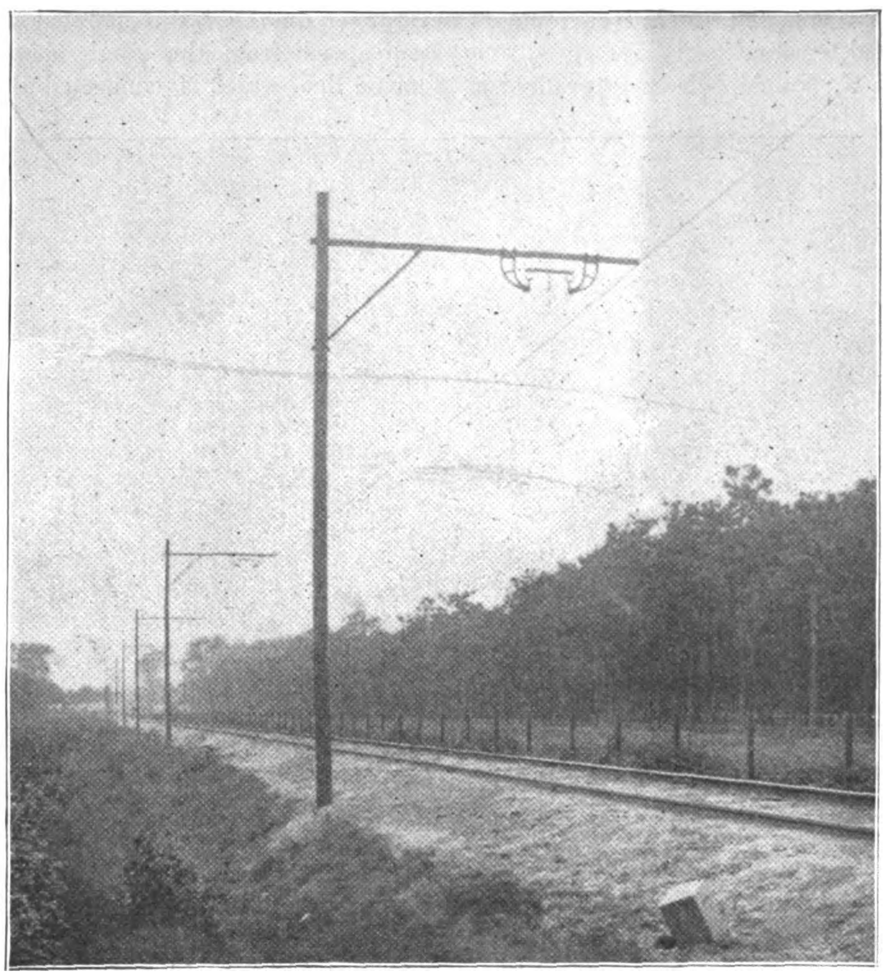

Fig 2.—View of Line, Single Phase Railway.

ELECTRICAL STATION PRACTICE.

ARTICLE XXXIV.

BY W. H. RADCLIFFE.

The plan of organization in an electrical station of medium size is generally as follows: At the head of the list are the stockholders whose opinions are voiced by the directors, and from the directors are chosen the executive committee which in turn selects the president. Under the president are the counsel, and the secretary and treasurer who keeps the funds and records. In addition to these the general manager, the general superintendent, the superintendent of construction, and the station engineer are under the president's supervision. Next to be mentioned are the steam engineer and fireman, the dynamo tender and cleaner, the lineman, lamp trimmers and night inspector; also the cashier, book-keeper, collector, and the storeroom keeper. This staff is conveniently divided into two sections, that of the office or financial department, and that of the station or operating department. In this series the management of the station or operating department is of primary importance and will be considered in the present article.

The most important factor in the successful operation of a given electrical station is the class of attendants employed. They should be chosen primarily for the knowledge and skill they possess in the performance of their duties, but hardly less in importance are the qualifications of sobriety and honesty. To secure and hold such men it is necessary to pay good wages, but money thus invested will bring good returns. One cheap man through carelessness will often damage and waste far more than the difference between the salary of a good man and that of his, can replace. It is true the pay roll forms the largest item in the operating expenses of an electrical station and should therefore be carefully watched, but to be consistent the cost of maintenance and depreciation must likewise be considered and compared with the salary account, as should also the number of accidents requiring a shut down of the plant. The last mentioned feature may not appeal so forcibly to one dealing only with dollars and cents, but frequent occurrences of this nature are apt to shake the confidence of the public and sooner or later assert itself in the patronage received.

The keynote of success in the manage-

ment of station employes is *system.* Without a system in which each person has certain duties assigned to him, it is almost impossible when an accident or blunder occurs to accurately fix the blame where it belongs. Not so, however, when the work to be done is properly divided and each task formally assigned to some one person who will thereafter be held accountable for the proper performance of the same.

Turning our attention now to the means that should be provided within an electrical station to facilitate the work of the employes, we will commence at the office for the officials. A desk, provided with pen, ink, pencil, erasers and scratch paper, should be installed therein for use in writing out daily reports, which as will presently be shown, are absolutely necessary in the systematic operation of the station. In order to keep a check on what is being done in a station, accurate reports should be required of the foreman in each department if the station be a large one; in a small or medium sized station, however, one report blank may be found to answer the purpose of all departments.

The report blank for an electric lighting station of moderate size should be ruled and printed in a similar form to that shown in Fig. 35. It is assumed, here, there are in commission four generators, numbered 1, 2, 3 and 4; two engines numbered 1 and 2, and two boilers also numbered 1 and 2. At the top of the blank appears the name of the electric lighting company, the name of the report and the date. At the extreme left is provided a column for recording the exact time at which observations are taken; this column, therefore, shows the exact time over which the report extends, and is generally one day, from midnight to midnight, during which half-hour readings of the volts and amperes supplied by each of the four generators should be

THE STEAM ELECTRIC COMPANY.

POWER HOUSE REPORT.

Wednesday, April 27, 1904.

Time.	Dynamo Nos.								Dynamo. Nos.	Started.	Stopped.	Hours Run.	Average Volts.	Average Amperes.	K. W. Hours.
	1		2		3		4		1 2 3 4						
	V.	A.	V.	A.	V.	A.	V.	A.	Engine. Nos.						
									1 2						
									Boiler Nos.						
									1 2						

Average No. Arc Lamps.
Average No. Incand. Lamps.
Total No. Incand. Lamp-hours.
Total No. Kilowatt-hours.
Kind of Coal Used.
Amount of Coal Used.
Amount of other Fuel Used.
Amount of Ashes Removed.
Average Temp. of Feed Water.
Average Temp. of Hot Well.
Evaporation lbs. Water per lb. Coal.

Supplies Received.	Supplies Used.

REMARKS.

Signed .... Chief Engineer.

FIG. 35.

taken and recorded in the proper columns under the respective letters V and A. In the first three columns at the upper right-hand portion of the report are recorded the times of starting and stopping, together with the number of hours' run made by the four generators, the two engines, and the two boilers. In the last three columns of this portion of the report are entered the average volts, the average amperes, and the number of kilowatt-hours supplied by the four generators during the 24 hours. These values are calculated from the half-hour readings recorded in the columns 1, 2, 3 and 4.

The determination of the average number of arc and incandescent lamps lighted during the 24 hours is important in that the receipts of an electric lighting company is generally estimated upon this average number of lamps as a basis. It may be well, therefore, to give the method of procedure in obtaining these figures. The average number of arc lamps lighted may be calculated directly from the average pressure of the arc light generator by dividing this number of volts by 50, the voltage of each lamp. The average number of incandescent lamps lighted is calculated from the average current of the alternator supplying the circuit. The standard for comparison is the 50 watt, 16 candle power, incandescent lamp which at 100 volts requires one-half ampere. From the ratio of the transformer employed, is determined the number of amperes in the secondary or lamp circuit for each ampere in the primary or alternator circuit; this of course will be inversely proportional to the ratio between the secondary and primary voltages. Since each lamp requires one-half ampere, the number of lamps supplied per ampere of primary current will be twice the corresponding number of amperes in the secondary circuit. Having now the number of lamps lighted for each ampere of primary current, this number multiplied by the average value of the primary current will give the average number of incandescent lamps lighted. From this figure the number of lamp hours may be determined if it be multiplied by the time in hours during which the alternator is supplying current to the lamps. Expressed in this manner the output is in a convenient form for comparison, or it may be that the total number of kilowatt-hours of output is preferable. In either case the information on this subject should be entered on the report as shown in Fig. 35.

Under the heading of Supplies Received should be entered every article of merchandise purchased during the 24 hours for the operation of the plant, and under Supplies Used must be recorded the amounts of the various supplies on hand that are used during this time. Under the heading of Remarks everything of particular importance in the operation of the boilers, engines, generators, or circuits should be noted; this comprises, of course, whatever accidents occur, their causes and results, the cleaning of boilers, and other affairs of similar nature that are necessary to make the report both complete and intelligible. If at any time the space provided on the report blank for Remarks is not sufficiently large, a separate sheet should be attached to the report blank and the remarks recorded thereon. At the lower right-hand corner of the blank a space is left, as shown, for the signature of the chief engineer.

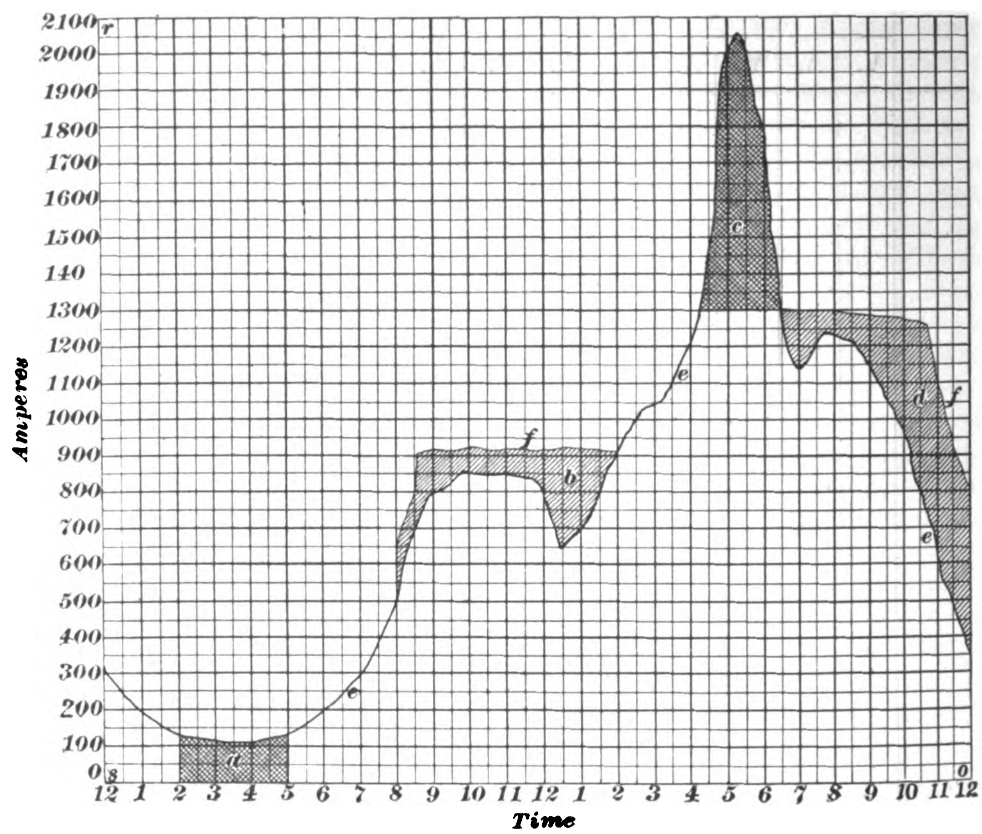

FIG. 36.

The readings recorded in the columns of a report may be rendered much more significant if they be plotted upon co-ordinate paper and a curve drawn. Station load curves thus obtained are particularly desirable for office use, and as an example the load curve for an electric lighting station equipped with a 110 volt, constant-potential generator and a storage battery, is presented in Fig. 36. Upon the horizontal line *s o* the time is laid off in hours, and upon the vertical line *s r* the current is laid off in amperes. The load curve is shown at *e e e*, and the shaded areas *a* and *c* represent the number of ampere-hours supplied by the battery to the line wires. Between the lines *f* and *f* and the curve *e e e*, the shaded portions represent the number of ampere-hours supplied by the generator in charging the battery. Following the plot from left to right it is seen that at 12 A.M. the generator was supplying the line with 300 amperes of current; that the current required diminished gradually during the next two hours, and at the end of that time the generator was replaced by the storage battery which latter supplied the current until 5 A.M. At this time the generator was again called into service to meet the increase of current required. At 8 A.M. a portion of the current from the generator was passed through the storage battery for the purpose of charging it, and the charging process was continued until 2 P.M. when the battery was found to be fully charged and was therefore disconnected. From 12:30 P.M. until about 5:15 P.M. the load increased rapidly reaching a maximum of 2,050 amperes at the latter time. Inasmuch as the maximum capacity of the generator was but 1,300 amperes, the storage battery was switched in multiple with the generator when the load reached this amount and supplied all the current required in addition to the 1,300 amperes. At 6:30 P.M. the load became sufficiently low to permit of a portion of the generator current being again used to charge the battery, and the plot shows that the charging process was continued throughout the remainder of the 24 hours.

An examination of the load curve in

Fig. 36 will suggest that between 2 A.M. and 5 A.M. while the generator, engine, etc., were not running, an excellent opportunity was afforded for cleaning or for repairing the machinery. The shaded portion *c* representing the amount of current supplied by the battery in excess of the maximum capacity of the generator is called the peak of the load, and it is in providing for this peak that a storage battery is of particular value for otherwise larger generators or a greater number of them would be necessary. This addition would not only increase the cost of the plant, but it would decrease its efficiency as a whole on account of the necessity of operating the generators and their respective engines during the greater portion of the time below their normal capacities and therefore at decreased efficiencies.

In issuing orders from the office, free use should be made of a bulletin board. Hereon should be posted by means of thumb-tacks any notices affecting the operation of the station, orders for revisions or corrections of preceding notices, and warnings regarding the use of high pressure circuits, etc. The bulletin board should be mounted within the station near the office, and in as conspicuous a position as possible; it should, however, be placed so as to be conveniently reached and read by all of the employes.

In keeping the time of employes a system of brass checks has been found to give good results. Each check has a number stamped upon it, and the employes are each given a number corresponding to that on one of the checks. The checks are hung on pegs mounted upon a board, the pegs being also numbered to correspond to the checks. This board containing the brass checks is hung outside the office about ten minutes before the time to commence work, and beside it is placed a box into which the employes are requested to drop their respective checks. It is advisable to place some one in charge of the board while it is being used to see that no employe removes any but his own check. As the whistle blows for commencing work, the box containing the checks of those on time is removed and replaced by an empty box which is left out for half an hour. An examination of the board and the contents of the second box will reveal at once those whose salary must be docked. The same procedure should be repeated at noon time, and an accurate account kept of the delinquent ones.

Next in importance to a well equipped office in the systematic management of an electrical station, is a well designed and properly equipped storeroom. This room should contain everything of a portable nature used in the operation of the station. Such articles should be kept under lock and key, and given out only as specified in orders written by the foreman. Printed order blanks should be used for the purpose and these when filled out and submitted should be placed on file and referred to in keeping the stock books and accounts. In a large station, the supplies should be in charge of one man whose duty it should be to keep account of all articles received and given out. In a small or medium sized station, the storeroom keeper may be assigned to other duties in connection to those just mentioned, but they should be such as not to necessitate his absence from the storeroom for an appreciable length of time. He may, for example, balance up the books, make out the daily reports, keep the time records of the employes, plot load curves, and do other work of a similar nature. It will be found in many stations that a storeroom conducted in this manner would more than pay for itself and keeper if consideration be taken of the daily loss and waste of supplies resulting from carelessness on the part of employes when no such system is in use.

In the management of a station every effort should be exerted to afford it the greatest protection in case of fire. Pump, pipes, hose, and fire-buckets should be installed in the station as already explained, and experience has shown that a well-organized fire company among the employes is of great value. In the latter case, each man should be assigned to a certain task in order that all of the station attendants may be employed to the greatest advantage.

OIL SWITCHES FOR HIGH TENSIONS.

The *Elektrotechnische Zeitschrift* publishes a belated report of an interesting paper read by Herr Vogelsang before the Electrotechnische Gesellschaft zu Koln, in which the author deals with oil switches for high tensions. After reviewing the changes which have been rung in the designs for high-tension generating plants since the first transmission scheme was carried out, the author goes on to say that modern practice has discovered two ways of constructing high-tension switches which can be relied upon to satisfy the more exacting requirements of to-day. One of these methods consists in the employment of the horn-break type of switch, while the other embodies the principle of interrupting the circuit under oil. Each has its advantages and disadvantages; the horn-break is only effective with heavy currents—the greater the current the more reliable is its action —a peculiarity which renders it especially adapted for use with fuses. On the other hand, the space which is required for its proper function is considerable. The author goes on to discuss the oil switch—incidentally describing a type constructed by Voigt and Haeffner, Frankfort-on-Main, which is exceedingly simple. A three-pole switch is provided with six contact jaws, to engage with which there are three blades, so that each pole is interrupted at two points simultaneously. The oil is contained in a removable vessel of tin. To those who have had to do with high-tension switches of other kinds, the quiet action of the above type is somewhat surprising, the interruption of the circuit being unaccompanied by noise. Experiments have shown that the formation of an arc under oil, just as in air, depends very largely upon the speed of the break. The author is of the opinion that the advantage of providing a large number of break points, especially in oil switches designed for very high tensions, will be more appreciated in the future, and thinks this principle better than that adopted by American engineers of employing extra long breaks under oil. He also points out that oil fuses are much less satisfactory in action than oil switches because in their case one point of interruption only per pole can be provided. Moreover, at the moment of interruption the particles of melted metal along the path of the fuse assist the formation of an arc. For this reason oil fuses are used only for moderately high pressures, that is up to 3,000 volts, and for relatively small currents. Within this limit oil fuses have proved thoroughly reliable. On the other hand, combination oil switches, in which the ordinary switch blades are replaced by fuses, have met with considerable success, especially in mines. But the practice of employing automatic cut-outs, instead of fuses, in conjunction with oil switches is quickly gaining favor, and it would almost seem that the use of oil switches with automatic releases in place of ordinary switches and special fuses has solved the difficulty hitherto connected with the breaking of high-tension circuits. The advantages of such an arrangement are obvious, especially in that the danger of fire which, in unfavorable circumstances, attends the blowing of high-tension fuses is avoided. In regard to oil switches with maximum current releases, the action is always indirect, being effected either by continuous current through the

medium of a relay or by alternating current through a rectifier. The latest phase in the development of this class of apparatus is the construction of automatic oil switches and cut-outs which can be operated from a distance. It is probable that this type of switch will find extensive employment for central-station work. Some interesting details of the several designs mentioned are included.—*Electrical Engineer, London.*

THE LATEST PROGRESS IN WIRELESS TELEGRAPHY.

BY EMILE GUARINI.

Translated for "Electricity" by Jean A. Wetmore, M. S., E. E.

(*Continued from page 215.*)

It will be interesting to observe the effects of the wind and the atmosphere upon the capacity of the antenna and consequently upon the length of the waves, during a relatively long period of time; for it is a fact that the wind varies the position of the wires in the antenna in respect to the earth and in regard to each other. Atmospheric variations, furthermore, cause a variation in the nature of the dielectric of the condenser, which is connected to both the antenna and earth.

As these variations are not the same at the two stations at the same moment, we can see that bad syntonization results from this fact.

As to devices for eliminating the effects of atmospheric disturbances, M. Ferrie has cited those of Messrs. Voirsenet-Tissot, Magne, Jehenne & Martin, Monnier, etc., but, as he has stated, none of them completely fulfills the requirements, which results in part from the fact that these phenomena are of an exceedingly variable and of little known character and that all of them cannot be prevented at the same time. The only means of suppressing the effect of the greater number is by considerably increasing the energy of the transmission and by using receivers of very low sensitivity, and it must be understood, a much greater energy in the transmitter. We have held to this opinion for a long time, and, furthermore, it is the simplest and surely the shortest means.

M. Ferrie then remarked further in regard to transmission troubles, that the theory recently proposed by Mr. Nordmann regarding the aurora borealis and of the presence of Hertzian waves in the atmosphere, seemed capable of explaining certain classes of these troubles, especially since the same transmission troubles were encountered by all the various users of new instruments.

We are given to understand that Mr. Marconi has installed two "Hertzian mills"—this expression of M. Ferrie is only too exact—at Poldhu and at Cape Cod, of 100 hp. each, for the purpose of communicating between England and America and without interfering with the ordinary stations in the near vicinity. For the purpose of utilizing the energy at his disposal, Mr. Marconi has recourse to commercial transformers, with a factor of 10, operated by a 2,000 volt alternating current. The device used for transforming this energy into Hertzian waves is shown in Fig. 9. A condenser, K, is ployed two self-inductors, F, F[1], one of them, F[1], is adjustible, and the other, F, has an impedance of such a character, that being in circuit, it prevents a flaming of the arc at C. The Morse signals are produced by a key, M, placed in shunt from the coil F.

Although no one has had any definite information respecting the length of the wave or of the antenna at Poldhu or Cape Cod, it is quite certain that this length is very great, taking into consideration the immense size of the antenna. This is the explanation why signals from Poldhu have never seriously inconvenienced the neighboring stations, particularly the one at Brest, 250 km. away.

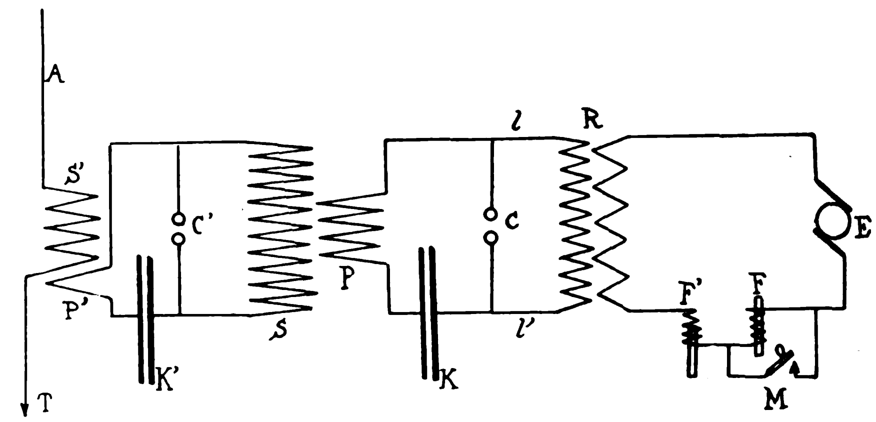

FIG. 9.

placed in derivation (shunt) to the terminals of the secondary of an industrial transformer, R, which is so chosen as to have such a capacity as to place it in resonance with the secondary. This condenser is discharged through an oscillator C, across the primary, P, of a Tesla transformer, which sets up oscillations having a very great wave length. These latter oscillations induce others, having a similar frequency, in the secondary, S, of a Tesla transformer and these last oscillations are used to charge a second condenser, K[1], to a very high tension, and this condenser in its turn is discharged through an oscillator, C[1], which is placed across the primary, P[1], of a second Tesla transformer, whose secondary, S[1], is connected to the antenna and also to earth. The capacity of K[1] is so determined that the oscillations due to its discharge may be in harmony with the period of the antenna itself. The various adjustments of the condensers and of the Tesla transformers are determined by experimenting. For the purpose of preventing the formation of an arc at the oscillator, C, it becomes necessary some times to blow it out by using a compressed air tube.

The alternating current is regulated in the ordinary manner by the insertion of self-induction governors in the transformer primary. There are usually em-

(Mr. Tissot has, however, written us that he has received dispatches emanating from Cape Lizard.) These stations are provided with antennæ whose wave length is only 200 meters at the greatest, and the multiple resonance produces effects which are much less appreciable than are the period differences themselves.

We will add that first, this proves that stations of different distance capacity cannot be interfered with by another, if widely differing wave lengths are employed; second, that extra powerful stations will remain immune from outside interference on account of the great difficulty in obtaining very great wave lengths. The difficulty from interference will become greater as these stations increase in number. However, here is an argument to support what we have just stated: When M. Ferrie quite recently set up communication between Paris and Belfort, by using antennæ supported by captive balloons, he received both at Paris and Belfort an interminable series of the letter S; the wave length of the antenna was about 2,000 meters; this proves not only that the wave from Poldhu may be received by a receiver not in unison, but also, M. Ferrie remarks, that communication between England and America is not yet an assured fact, as they are all the while at work with the letter S. This

conclusion may be objected to by saying that Mr. Marconi uses the letter S all the while in his experiments with new devices, because it appears to be capable of the greatest distance transmission and because it requires a smaller consumption of energy.

The Military Telegraph Service has, in its course of experiments which were undertaken with the valuable co-operation of the Central Light House Service, tried to secure a comparison of the losses suffered by using a continuous current and induction coils, with those by which the object could be obtained by employing alternating currents. The energy used in all these instances was less than 1 kw.

Directly excited devices, and those of Braun-Marconi, have been used with induction coils, and experiments not only

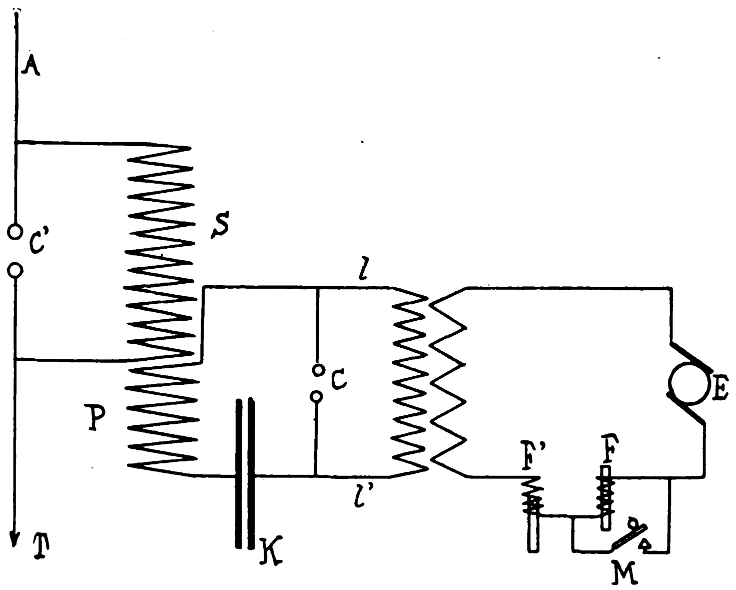

Fig. 10.

with the Marconi devices, but still other arrangements, some of which have been experimented with by M. Blondel in 1900, have been used in conjunction with industrial transformers and alternating currents.

In particular, instead of employing, as Mr. Marconi has done, oscillations of very long wave lengths and of high tension, supplied from the first Tesla transformer (Fig. 9) for the purpose of charging a second condenser, it may be used to charge the antenna, which is discharged through a second oscillator, C^1 (Fig. 10). A better output is thus obtained. This arrangement is analogous to the direct spark device having induction coils. A better output is obtained, in our opinion, first, because there is one less transformer and conseqently there is a smaller loss; second, because here the same thing happens as with a simple directly operated outfit, i.e., that the larger part of the energy becomes dissipated during the first oscillation, whilst in the Marconi device (Fig. 9) the energy is subdivided into a large number of obviously equal oscillations.

For the purpose of still further increasing the output, one can also, as M. Ferrie remarked, use several Tesla transformers in parallel, operated by distinct oscillating circuits, but mounted on the same industrial transformer.

An analogous arrangement has been described, discussed and illustrated by us in the *Scientific American Supplement* of May 9, 1903.

The results, secured by the above-named investigations have been the following: The receiving taking place at the coherer, the advantages secured have been decidedly in favor of induction coils and directly excited apparatus, by which results have been secured at a distance of about 400 km. with a 15 meters height of antenna, although all the other direct excited devices (continuous and alternating currents) have not been able to carry further than 300 km., but it is really necessary to remark that it has not been possible to utilize a much greater energy by using the induction coils, that is to say, to notably increase the carrying distance, whilst by using alternating currents, they were able to utilize a very much greater energy and consequently were able to considerably increase the distance communicated over. But is that truly necessary to successfully telegraph without wires over a long distance? Is there not also an intermediate station system? This system seems to have been forgotten.

Mr. Slaby has built at Oberspree, near Berlin, for the A. E. G., a specially powerful station, similar to the one at Poldhu, and in which he has used alternating currents and commercial transformers. The device (Fig. 11) is as follows:

A condenser, K, is connected in a short circuit from the secondary of a commercial transformer and so chosen as to be capable of setting up a resonance from the secondary circuit. The condenser is discharged through an oscillator, C. The antenna, A, is run to earth direct and is simply connected to the oscillating circuit by a connection, L. It consequently forms part of the vibratory movement,

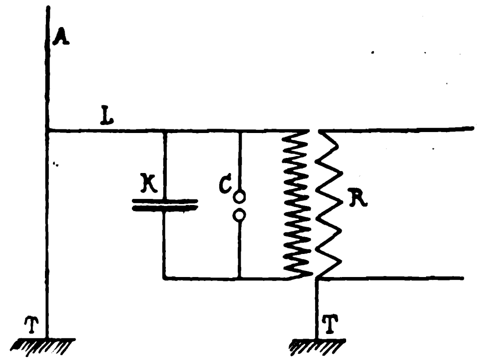

Fig. 11.

but, as M. Ferrie remarks, it is difficult to conceive, in the absence of more precise data, how the output could be desirable. In fact it seems improbable that the antenna should utilize a substantial portion of the energy from the exciting circuit. Furthermore, we are not acquainted with the results obtained with this apparatus.

Relative to installing an extra powerful station with this device, we would state from the start, that even though energy should reach the antenna, that the greater part of the energy must necessarily be lost in the circuit formed, while that portion which reaches the derived circuit would be divided between the earth and

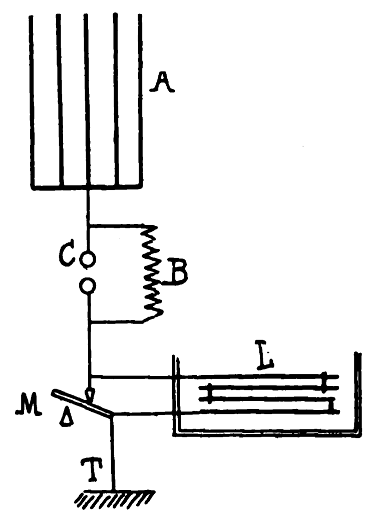

Fig. 12.

the antenna. On the other hand, Mr. Slaby positively states, as one of the great advantages of such a device, that the contact with the antenna is free from danger, since the latter is grounded and offers a free track for atmospheric discharges.

After some remarks devoted to the

proposition of Mr. Cooper-Hewitt relative to the utilization of the property of mercury arcs for furnishing slowed-down oscillations and regarding devices proposed by M. de Valbreuze, M. Ferrie took up the Fessenden transmitter, which he considered as being based on a new theory which is "quite mysterious." The antenna, A, is excited directly by an inductive coil, B, which has an oscillator, C (Fig. 12). The spark being permanent the transmission results from a suppression of the short circuit through the plates, L, by means of the key, M, M. Ferrie considers it difficult to understand the advantages which such a device may present, since the antenna vibrates generally in quarter wave, whatever may be the point where the oscillator is inserted. The manipulation of the key, M, would consequently have no other effect than that of changing the period of the oscillations produced.

It appears to us to be pertinent to remark here that since syntony allows of a much greater transmission distance through the better utilization of the energy, it is clear that if the receiver is placed near the limit of reception it will not receive, except when it is in harmony, i. e., when by manipulating the key the short circuit harmonizing device is suppressed. It is also to be noted that for the same reasons the Fessenden apparatus is useless on the sea, since in this instance the distances between the stations are always variable. On the other hand, the continuous operation of the transmitter has the great advantage in allowing of considerable increase in the speed of transmission, especially in powerful stations, and there is no moving interruption or loss of time in setting up a current in the primary. The time constants in wireless telegraphy, as well as with telegraphy by wire, depends on the capacity and the self-induction of the circuit.

(*To be continued.*)

ELECTRICAL EQUIPMENT OF A CANAL.*

BY F. H. LEONARD, JR.

The electrical equipment for the Cornwall Canal in Canada is supplied with current from a power house near Mille Roches on the canal. There are 225 arc lights located along the bank. A three-panel switchboard controls the operation of these lamps and each circuit is regulated by a 100 light regulator capable of maintaining practically constant current with any number of lamps in circuit from 1 to 100—its full capacity. The current for these circuits is stepped up from 2,200 volts by means of transformers of 60 kw. each—the transformers being provided with intermediate taps so that besides the full voltage of 11,000 volts, if a smaller number of lamps are required, either 4,400 or 6,600 volts can be used, thus reducing the reactance necessary to maintain a proper voltage and permitting of a higher P. F. under the conditions of partial load.

Current for the power circuits, three in number, is obtained by stepping up from the generating voltage to 11,000 volts by means of three 150 kw. transformers which supply the three-phase transmission lines reaching various locks along the 11 miles of canal. The primaries of both arc lighting and power transformers are controlled by oil switches connected to the bus bars on the main switchboard, a separate panel being provided for each class of service. The power circuits are passed through a separate high potential switchboard which connects the transformers to the three separate three-phase power lines. A 2,200 volt line also provides Mille Roches with light and power service.

The pole lines for the lighting and power circuits are of substantial structure, an exceedingly straight lot of cedar poles being used. These range from 30 to 50 feet in height, none having less than 7 inch tops, on which are mounted special cross-arms provided with hickory pins which were boiled in steric acid, 5½ inch triple petticoat glass insulators being used with satisfactory results with the 10,000 volt circuits. Bare copper conductor is used spaced 16 inches on centers, and on account of the low current per line no attempt was made to use the triangular arrangement of conductors, the three wires of each circuit being arranged side by side without transposition.

The three-phase power circuits occupy the upper arms and on the lower arms are located the single-phase arc circuits. The main lines occupy the south bank of the canal. Crossings are made at the Mille Roches bridge in armored paper cables, one for three-phase 2,200 volt power and lighting circuits and another for the single-phase 11,000 volt arc circuit. Another crossing is made at lock 18, which provides for three-phase power circuit, as well as another 11,000 volt arc circuit to provide for power and lighting on the north bank below this point. At the Stormont bridge, near Cornwall, another 11,000 volt arc cable provides for lighting the two piers at the bridge and an emergency cable is laid just above lock 17 so that in case of accident to any of the other crossings or a break in the line, emergency connection can be made in the houses covering the cable heads on the bank of the canal.

LIGHTING.

The lighting of the canal is carried out in a very liberal manner, an arc lamp being located on every fourth pole and the poles averaging about 100 feet apart. At the locks as many as 12 or 14 lamps are located so as to brilliantly illuminate both ends of the locks, as well as the intervening space and the regulating weirs, most of which are located beside the locks.

The lamps are hung from iron pipe brackets which pass through the pole and are held in place by a collar at the front side and a lock nut at the back and braced on the under side by an iron pipe strut fastened to the face of the pole by two lag screws. An insulated hanger is used at the outer end of the bracket (2 feet and 6 inches from the pole), which, together with the insulators on the lamps, renders danger from grounding in the lamp frame and bracket extremely remote. The lamps are trimmed from the pole without lowering; pole steps are driven in each lamp pole.

At the lower end of the canal, where three sets of locks are grouped together, the illumination is very brilliant, and viewed from the Stormont bridge at Cornwall—taking in at a single glance some 60 arc lamps reflected in the still waters of the canal—the sight is most impressive in its quiet brilliancy. The illumination of the locks is so much alike that a description of one will convey a very clear idea of them all.

A light is located at the piers as the lock is approached from below and an arc lamp is also located at each side of the lock just below the gate; two more lamps are located at the middle of each lock and two at the upper end of the lock just at the lock gates. There are also two more at the upper piers, and as two locks are located side by side, you can imagine that the illumination would almost rival daylight.

The upper level broadens into a lake of considerable proportions, about 30 feet deep near the lower end. The dam retains the water between Shieks Island and the Canadian shore, making a broad and easy navigable waterway of about three miles to the upper dam. The lamps are here less frequently located on the prominent points on the south side until the upper dam is reached, when the canal again narrows to the usual dimensions. The lamps are again located about 400 feet apart on the south bank up to lock 21,

*Abstract of paper read before the Electrical Section of the Canadian Society of Civil Engineers, Montreal.

which is a guard lock, there being very little difference between the upper canal level and the St. Lawrence River at this point. On the long pier on the south side protecting the canal entrance lamps are placed, as well as on the north bank as far up as Dickinson's Landing.

An illumination so perfect as above described, you can readily imagine makes navigation at night as easy as in daylight, and lockages are performed as rapidly and as easily as they could be in day time.

(To be continued.)

National Electric Light Association Convention.

Editor ELECTRICITY.

SIR: The programme for the 27th Convention of the National Electric Light Association is rapidly taking definite shape. Papers and reports already in press are as follows:

"Wrinkles," edited by Charles H. Williams of Madison, Wis.; Report on District Heating, E. F. McCabe, chairman; Report on Purchased Electric Power in Factories, W. H. Atkins, chairman; Report on Advertising, La Rue Vredenburgh, reporter; Report on Decorative and Sign Lighting, Arthur Williams, reporter; papers entitled "The Sale of Electrical Energy," by W. F. White; "Practical Notes on Steam Turbines," by Francis Hodgkinson; "A One Hundred Mile Transmission Line," by Robert Howes; "Economy Test of 5,500 Horse Power Engine and Generator," by Messrs. J. D. Andrew and W. F. Wells; "The Remote Control of Electrical Apparatus," by W. H. Cole.

It has been decided to hold the meeting for four days, the last day to be reserved for entertaining and sightseeing in Boston and vicinity, full particulars of which will be announced soon.

ERNEST H. DAVIS, Secretary.

About Graphite Brushes.

Imperfect commutation and its accompanying sparking is an evil that never grows anything but worse.

Copper brushes are much more prone to cause this than carbon, and carbon than graphite, simply because graphite brushes offer a higher resistance to self-induced, back currents in the coils, at the moment of commutation.

If graphite brushes are made of pure material and have sufficient contact area, they will reduce sparking to its minimum and will entirely stop any increase due to increasing roughness of wearing segments.

Graphite, from its peculiar nature, puts a smooth surface and high polish on the commutator without the employment of any lubricants or "compounds," and will not cause any appreciable wear, even after long periods of steady use.

In our engine room is a 100 kw. unit that has run steadily for three years at 250 r.p.m., and 10 hours a day, and its commutator is glassy-smooth, cool, and the wear scarcely detectable after this steady service.

The greatly increased and rapidly increasing sales of Dixon's Graphite Brushes bear strong witness to their superiority, on every count, to the cheaper gritty carbon so recently thought indespensable.

G. P. H.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 19, 1904

Electric Railways and Appliances.

757,471. Traction-Band for Wheels. Le Grand Kniffen, Chicago, Ill. Filed Sept. 28, 1903.

757,537. Method of Signaling for Electric Railways. Samuel M. Young, New York City. Filed Nov. 6, 1903.

757,630. Safety Device for Trolley-Poles. Phelam McCullough, Thomas Blaney and Robert Baron, Liverpool, Eng. Filed Jan. 22, 1901.

757,635. Tread for Traction-Wheels. John W. Pridmore, Chicago, Ill., assignor to the International Harvester Company, same place. Filed Aug. 16, 1902.

757,650. Means for Cleaning the Third Rails of Electrical Railways. Wilfrid Chausse, New York City. Filed Sept. 30, 1903.

757,692. Block-System Emergency Apparatus. Frederick V. Thompson, Philadelphia, Pa., assignor of one-half to Frank Baker, same place. Filed Jan. 10, 1903.

757,746. Car-Fender. Harry Howe, Toledo, O. Filed Dec. 10, 1903.

757,845. Car-Fender. Earl Sherwood, Honesdale, Pa. Filed Aug. 22, 1903.

757,906. Electric Railway. George H. Fretts, Springfield, Mass. Filed July 14, 1903.

757,985, Traction-Engine. Frank C. Watson, Des Moines, Ia., assignor to the Avery Manufacturing Company, Peoria, Ill. Filed Aug. 6, 1902.

Electric Lights and Appliances

757,564. Electric Headlight. William H. Northall, Elwood, Ind Filed March 20, 1903.

757,659. Electric-Arc Lamp. Robert Hopfelt, Berlin, Germany. Filed May 13, 1902.

757,695. Electric Lighting and Power System, William A. Turbayne, Buffalo, N. Y., assignor to Charles M. Gould, New York City. Filed Jan. 13, 1902. Renewed Sept. 29, 1903.

757,782. Electric Arc-Rupturing Device. Sidney H. Short, London, Eng., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 11, 1902.

757,847. Electric-Arc Lamp. Frederik Sindingchristensen, New York City, assignor, by direct and mesne assignments, to the Commercial Construction Company, same place, and William H. Locke, Jr. Filed May 4, 1903.

757,958. Electric-Arc Lamp. Isaac W. Percival, St. Louis, Mo., assignor, by mesne assignments, to the Westinghouse Electric & Manufacturing Company. Filed Jan. 23, 1899.

Electrical Machinery and Apparatus

757,436. Electrical Generating System. William A. Bole, Pittsburg, Pa., assignor to the Westinghouse Machine Company. Filed July 12, 1901.

757,439. Prepayment Electrical Measuring Instrument. Frank Conrad, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 24, 1903.

757,515-516-517-518. Phase Regulation, Phase-Angle-Adjusting Means and Method of Phase-Angle Adjustment. Egbert M. Tingley, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Original application filed May 9, 1896. Divided and last application filed Feb. 4, 1901.

757,523-524-525. Induction-Coil. Richard Varley, Providence, R. I., assignor to the Varley, Duplex Magnet Company. Filed Dec. 14, 1903; Dec. 30, 1903, and Jan. 12, 1904.

757,527. Vibrator for Induction-Coils. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed Jan. 20, 1904.

757,765. Insulator. John W. Osborne, Winchester, Ill. Filed Aug. 15, 1903.

757,853. Electric Switch. George H. Whittingham, New York City, assignor to the Automatic Switch Company of Baltimore City. Filed Oct. 29, 1903.

757,880. Electric Rheostat. Roy W. Brown, Amsterdam, N. Y. Filed April 21, 1903.

757,898. Electric Controller. Arthur C. Eastwood, Cleveland, O. Filed Jan. 30, 1904.

757,925. Electric Switch. Charles F. Hopewell, Cambridge, Mass., assignor to the Uni Signal Company. Filed Oct. 7, 1903.

Telephones and Telephone Apparatus.

757,609. Electrical Telephone Apparatus. Pliny H. Fisk, Clay, Ia. Filed June 13, 1903.

757,799. Telephone Transmitter. Walter L. Wilhelm, Buffalo, N. Y., assignor to the Wilhelm Telephone Manufacturing Company, same place. Filed Jan. 23, 1902.

757,826. Telephony. Albert Meinema, Chicago, Ill. Filed Jan. 16, 1904.

757,850. Antiseptic Attachment for Telephones. Hugh L. Thompson, Waterbury, Conn. Filed March 1. 1904.

758,031. Telephone Desk Set. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company. Filed May 26, 1902.

Miscellaneous.

757,446. Secondary Battery. Louis H. Flanders, Wilkinsburg, Pa., assignor to the Westinghouse Machine Company. Filed July 10, 1903

757,495. Electric-Sole Shoe. Adam Reed, St. Joseph, Mo. Filed Feb. 4, 1904.

757,503-757,504 Telegraph System. Harry O. Rugh, Chicago, Ill., assignor to the Western Telegraphone Company. Filed Aug. 31, 1903.

757,505. Telegraphy. Harry O. Rugh, Chicago, Ill., assignor to the Western Telegraphone Company. Filed Aug. 31, 1903.

757,557. Electrolytic Deposition Apparatus. William J. Jory and Joseph H. Jory, San Francisco, Cal. Filed April 7, 1903.

757,559. Wireless Telegraph System. Guglielmo Marconi, London, Eng., assignor to the Marconi's Wireless Telegraph Company, Limited. Filed Nov 19, 1901.

757,603. Mechanism for Holding Electrotype Plates. Charles W. Eberhard, Chicago, Ill. Filed June 30, 1903.

757,618-757,619-757,620. Process and Method of Electric Heating. William S. Horry, Niagara Falls, N. Y., assignor to the Union Carbide Company, same place. Filed April 5, 1902; filed April 28, 1902; filed June 6, 1902.

757,621. Electric Furnace. William S. Horry and Edgar F. Price, Niagara Falls, N. Y., assignors to the Union Carbide Company, same place. Filed Oct. 11, 1902.

757,633. Electric Heating. Edgar F. Price, Niagara Falls, N. Y., assignor to the Union Carbide Company, same place. Filed April 5, 1902.

757,634. Electric-Resistance Furnace. Edgar F. Price, Niagara Falls, N. Y., assignor to the Union Carbide Company, same place. Filed April 30, 1903.

757,670. Electrically-Heated Soldering-Iron. Alfred C. McCloskey, Philadelphia, Pa. Filed May 6, 1903.

757,722. Electric Semaphore. Dona Boisvert, Providence, R. I, Filed Oct. 13, 1902.

757,736. Multiplex Telegraphy. John J. Ghegan, Newark, N. J. Filed July 3, 1902.

757,768. Signal Apparatus. Jonathan D. Price, Aurora, Ill., assignor to the Miller Signal Company, Chicago, Ill. Filed Jan. 21, 1902.

757,773. Electric Fan. Frank N. Roehrich, Brooklyn, N. Y. Filed Dec. 10, 1901.

757,817. Process of Electrolytically Extracting Copper and Zinc from Ores. Stanislaw Laszczynski, Kielce, Russia. Filed Oct. 10, 1902.

757,943. Storage Battery. Abraham V. Meserole, New York City. Filed July 13, 1903.

758,004. Device for Wireless Telegraphy. John A. Fleming, London, Eng., assignor to the Marconi's Wireless Telegraph Company, Limited. Filed April 8, 1901.

758,005. Apparatus Employed in Wireless Telegraphy. John A. Fleming, London, Eng., assignor to the Marconi's Wireless Telegraph Company, Limited. Original application filed April 8, 1901. Divided and this application filed Nov. 9, 1901.

758,006. Wireless Telegraphy. Francis J. Green, Detroit, Mich., assignor to the American Engineering Company, Detroit, Mich. Filed Jan. 9, 1903.

THE TELEPHONE WORLD.

Telephone War in Independence, Mo.

The telephone fight in Independence is raging hot and furious, as much so as in Kansas City. The greater portion of the merchants have decided to use one 'phone and concluded to disconnect the Bell 'phone on May 1, and have given public notice to that effect. There will be some of the merchants who will use both 'phones, and so the fight goes on merrily. The Bell and the Home have about the same number of subscribers in Independence, and the notice was given so that the residents of the town could take up the matter and dispose of it to suit themselves.

Reorganization of Independent Company in Iowa.

The E. H. Martin Telephone Company of Webster City will reorganize with a capital stock of $300,000, retaining its present headquarters in that city. This company owns and operates the Postal Telegraph lines in that section of the State, as well as leases to other parties nearly 1,000 miles of telegraph lines. The Martin Company is one of the strongest Independent telephone companies in the State, covering eight counties.

J. M. Oliver, of Orlando, Fla., says that he is making arrangements to build a telephone line from Jacksonville to Tampa, and expects to include Bartow, by building a line from there to Bartow Junction. The enterprise is to be known as the Florida Co-operative Telegraph & Telephone Company, and it is to be incorporated at $100,000, 75 per cent. of which he and his family will subscribe for. The remaining $25,000 will be issued in co-operative stock, at $100 per share, and he desires to place this at different points along the line. He expects to begin active operations by May 15, and will have about 300 men, divided into eight gangs, working from Jacksonville, Orlando, Bartow, Tampa and other points in every direction where it is determined to build the telephone line.

The Eldon, Ia., Independent Telephone Company, with about 250 miles of lines through Wapello, Davis, Jefferson and Van Buren Counties, has been sold to Clyde A. Mann, of Sioux City. It is understood Mr. Mann has completed arrangements by which a Cedar Rapids company will look over the properties of the Eldon company.

The Phoenixville Pa., Telephone Company was lately organized and a temporary organization effected by the election of nine directors and the adoption of a constitution and by-laws. The directors will select from their number a president, secretary and treasurer.

Men engaged in the electrical and telephone business in North Dakota are to hold a convention at Grand Forks, May 11 and 12, for the purpose of forming a State organization.

The Warwick, N. Y., Telephone Company has announced an increase of 50 per cent. in rates, to become operative July 1.

The Campus, Ill., Telephone Company, capitalized at $2,500, was recently formed.

Pennsylvania Company Reorganized.

Messrs. Charles West, W. G. Harding and associates, of Wilkes-Barre, have recently purchased the Citizens' Telephone Company of Honesdale. The Citizens' Telephone, is an Independent company in opposition to the Bell Company. It has been reorganized under the name of the Honesdale Telephone Company with a capital of $40,000. It now has 250 local telephones. The new management already have contracts for 100 additional 'phones which will be installed immediately. A long-distance line will be built to Carbondale which will give the company's patrons long-distance connections with all the extensive territory covered by the Consolidated Telephone Companies of Pennsylvania, and through its allied companies with towns and cities in New Jersey, New York and Pennsylvania.

Farmers of Montgomery County, Ala., are determined to secure a telephone system connecting the rural homes. At a recent well-attended meeting of the Montgomery Agricultural Association the executive committee was authorized to canvass the farmers of the county and ascertain how many of them would contract for telephone service.

Telephone lines on the two principal roads to the south and east of Holley, N. Y., are now practically assured. Two years ago a line was built on the Holley road as far as Clarendon. This line will now be continued about four miles farther to Honest Hill. A line also will be built, according to the plans, along the main road to Bennetts Corners, and from there south a distance of seven miles.

Arthur G. Dickson, of Philadelphia, Pa., special master, appointed by the United States Circuit Court in Easton, Pa., sold the lines and system of the New Jersey & Pennsylvania Telephone Company to J. Davis Broadhead, of South Bethlehem, attorney for the bondholders, for $25,000. The lines are operated extensively through that section.

After years of patient waiting, Red Creek, N. Y., was recently admitted to the telephone world, and placed on the map. A deal was closed which means much to Wayne County as well as the immediate vicinity.

The Inter Ocean Telegraph & Telephone Company has about 2½ miles of cable in Fairport, N. Y., ready to string for its exchange as soon as the village authorities and the company decide on the location of poles.

The Syracuse, N. Y., Telephone Company, of which J. J. Jermyn is president, has in mind an automatic system for that city, and with this end in view systems of that character will be inspected in other cities.

The Waterbury, Conn., Automatic Telephone Company has filed with the Secretary of State a certificate of increase of capital stock from $10,000 to $50,000.

The Gayes Mutual Telephone Company of Mattoon, Ill., has increased its capital from $2,400 to $4,980.

Underground Wires for Clarion, Ia., Company.

The Clarion & Northwestern Telephone Company is making arrangements to place all the wires in the business section of the city underground, and it is expected that if the experiment proves successful the entire system of wires will be thus placed. There is no city ordinance requiring underground wires, but the directors of the company state that they believe this the only satisfactory method, as their loss in times past from storms has been considerable. The company will expend about $1,500 in purchasing cable and other supplies needed for the change to an underground system, and work will commence as soon as the weather permits.

Telephone Improvements in Maine.

The success of the Northeastern Telephone Company in securing permits to enter Lewiston and Auburn has set the New England Company to thinking about increasing its facilities and improving its service in other cities. In Augusta the business has developed to such an extent and the number of subscribers has increased so rapidly, that the present accommodations of the operating room and central office over the Maine Central station are entirely inadequate, and it is the intention of the company to erect a new and commodious building that will improve the service and meet all the requirements of the public.

Another telephone line between West Exeter and West Winfield, N. Y., will be put up as soon as the season will permit. It will be known as the Twentieth Century Line.

The new building of the Vermilion County Telephone Company, to be erected in Danville, Ill., will cost $16,000.

The Dewitt, Neb., Telephone Company has filed notice of an increase in its capital stock from $10,000 to $20,000.

A new telephone line has just been completed and put in operation between Terrell and McCoy, Tex.

The street telephones, operated in connection with the Wisconsin Telephone Company's system in Milwaukee, have proven a success.

The Green Spring Telephone & Electric Company of Green Spring, O., has increased its capital stock from $20,000 to $35,000.

The Canotton Valley Telephone Company of Jewett, O., has increased its capital stock from $2,000 to $9,000.

Telephone Incorporations.

The Fountain Creek Telephone Company, East Lynn, Ill. Capital stock, $34,000, Incorporators: W. A. Yeasel, G. H. Wieland and H. C. Tucker.

The Farmers & Merchants' Telephone Company Arlington, Minn. Capital stock, $10,000. Incorporators; Adam C. Buck, Henderson; John Young, Frank F. Mansfield, Albert Zimmerman, Theodore Streissguth, Vincent F. Schmoll Henry Hillemann and August C. Maillin of Arlington.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Belle Fourche, S. D.—C. H. Williams, an electrical engineer of Deadwood, is making an effort to organize a company to erect an electric lighting plant. Plans have been drawn for the building of a plant to cost $8,000.

Bloomingdale, Mich.—The people here are agitating the subject of electric lights.

Bottineau, N. D.—The power house of the electric light plant was lately destroyed by fire.

Broxton, Ga.—Local capitalists are going to establish an electric light plant here.

Burgaw, N. C.—John W. Reilly, of the firm of J. W. Reilly & Son, of Wilmington, will confer with parties here relative to the installation of an electric lighting plant.

Castledale, Utah.—W. E. Raines, engineer of Salt Lake City, will submit the estimated cost of the proposed electric light plant to the boards of Orangeville and this town. A. C. Van Buren is president of the Orangeville board.

Central City, Kan.—C. H. Blandford, city clerk, states that an electric light plant for this place is being contemplated.

Citronelle, Ala.—It is reported that an electric light plant and ice factory will be erected here. Address H. O. McMair, cashier of the First National Bank.

Clarksville, Ark.—The city council has granted Col. E. T. McConnell, a resident capitalist, a 30-year franchise for an electric light plant. Work on the plant is to be commenced at once.

Columbus, Neb.—H. H. Childs, representing an Omaha electrical supply house, has submitted a proposition to the council to install an electric lighting plant at the waterworks station at a cost of $4,000 to $5,000, which will be considered.

Dover, Del.—The proposition to borrow $6,500 for the improvement of the electric light plant is being discussed.

Eaton Rapids, Mich.—The citizens have voted to bond for $12,000 to purchase the electric light plant of this city.

Eureka, Cal.—Robert M. Pringle, supervisor of engineering, or John Charles, supervisor of construction, will make necessary plans for installing an electric light plant at Hoopa Reservation.

Farmer, N. Y.—This village is soon to have electric lights,

Flora, Ind.—It is reported that $28,000 will be spent on the construction of an electric light and waterworks plant.

Garrison, Ia.—The matter of securing an electric light plant is under consideration.

Hannibal, Mo.—William O. Webster, of 2949 LaClese avenue, East St. Louis, Ill., is interested in the electric light and power plant projects here, and will have charge of all arrangements. Work is to be started by May 1.

Hattiesburg, Miss.—An ordinance was lately passed by the board of aldermen authorizing the issuance of $60,000 bonds to build or buy a complete electric light plant.

Hooper, Neb.—The Hooper electric light plant was recently damaged by fire. The dynamo is almost a complete loss. Mr. Martin, proprietor, carried $1,500 insurance, which will not cover thel oss.

Huntington, Ind.—Roanoke is about to make arrangements with the Ft. Wayne & Southwestern Traction Company, whose power house is in this city, for electric lighting for streets and business blocks.

Ipswich, Mass.—The city council has appointed a committee of five to look after the electric lighting system, and see about extensions and other matters pertaining to the lighting of this city,

Lewiston, Pa.—The contract for street lighting has been awarded to the Lewiston Electric Light Company at $65 per light.

Moberly, Mo.—The Moberly Light, Power & Fuel Company has been granted the right to construct, maintain and operate an electric and gas light, power and fuel plant here.

Mooresville, N. C.—C. V. Vails states that electric lights are under consideration.

New Athens, Ill.—An electric light plant is to be built here.

New Harmony, Ind.—George C. Morgan, C.E., 169 Jackson Boulevard, Chicago, is reported to be preparing plans and specifications for an electric light plant for this city.

Santa Barbara, Cal.—A new gas and electric light plant is planned, for which $50,000 has been subscribed. The promoters expect to soon have $200,000, the amount necessary with which to begin the work. The council will be asked to grant a franchise to the new company.

Vancouver, B. C.—The department of the Columbia has decided to adopt electric lights. The barracks have heretofore been lighted with kerosene. The system has given much dissatisfaction. The new contract will amount to several thousand dollars annually.

Viola, Ill.—The electric light question is being discussed here.

Waverly, Tenn.—It is reported that J. J. Jones will improve the Waverly Electric Light Company's plant.

Wilton, Ia.—George Bennick, mayor, has called a special election for May 2 to vote on the question of issuing additional bonds for improving the electric light plant and waterworks system.

Youngstown, O.—G. E. Turner and others are organizing a company, it is stated, to build an electric light and power plant, to cost about $30,000.

STREET RAILWAYS.

Coalgate, I. T.—C. W. Copeland, of the Lehigh Traction Company, states that the construction of a trolley line between here and Lehigh is a certainty.

Fort Collins, Col.—W. O. Mossman has secured a franchise from Larimer County, giving him a right of way for an electric railway leading from a point 20 miles northwest of here to North Park. He must file maps of the route selected with the county clerk on or before April 30, 1905, and within 10 years thereafter an electric railway must be in operation.

Minneapolis, Minn.—The Minneapolis-Champlain & Bloomington Electric Company proposes to extend its lines.

Missouri Valley, Ia.—Capitalists have been here who, it is said, have plans on foot whereby this place will be connected with the Illinois Central by an electric road.

Niagara Falls, N. Y.—A franchise for a cross town electric railway through this city has been granted the Electric Railway Company.

Pavilion, N.Y.—The Buffalo & Depew Electric Railroad Company proposes to build an electric line to Oatka Valley.

Philadelphia, Pa.—About 25 miles of new line will be added this year to the Philadelphia Rapid Transit Railway system, which will be extended in many directions.

South M'Alester, I. T.—A movement is on foot to incorporate an electric line extending from here to Oklahoma City via Lehigh, Coalgate and Shawnee. The line will be over 200 miles long, and will handle passengers, freight and express business.

Syracuse, N. Y.—Manager Connette, of the Rapid Transit Company, states that the company is trying to secure right of way to North Syracuse.

Trenton, N. J.—The Vandegrift Construction Company proposes to build a new trolley system between this city and New Brunswick.

West Chester, Pa.—H. H. Hoch, of New York, is the prime mover in the construction of a trolley line between this place and Wilmington.—Mr. Schamberg proposes to build a new trolley system here to cost $600,000.

Winder, Ga.—The electric car line which is now being planned from Anderson, S. C., via Hartwell, Commerce, Jefferson, Winder and Logansville to Atlanta, is in charge of the Georgia Traction Company. The line will be used both for passenger and freight transportation. Local towns along the line are asked to subscribe enough stock to grade the roadbed.

BIDS WANTED.

Black Diamond, Cal.—Bids are asked by T. M. Donovan, town clerk, until May 17, for a franchise authorizing the construction of poles on the streets of this place, for carrying wires to transmit electric heat and power, as applied for by the Redwood Manufacturers' Company.

Delaware City, Del.—Sealed proposals in triplicate, for constructing, plumbing, heating and electric wiring 12 bed hospital at Fort Mott, N. J., will be received until 11 A.M., May 16. U. S. reserves right to reject or accept any or all bids. Information furnished by Louis F. Garrard, Jr., Capt.,Q. M. Department, of this city.

Manitowoc, Wis.—The William Rahr Sons Company will install two electric generators of 250 and 100 kw. capacity respectively, in their malting plant here; and also 25 electric motors, ranging in power from 1 to 50 hp., for which bids will be received. Reinhardt Rahr is secretary and treasurer.

New Freedom, Pa.—Bids will be received until April 30 for the construction of an electric lighting plant. Address W. H. Lowe, secretary.

Traverse City, Mich.—Sealed bids will be received until May 31, for the lighting of the streets of this city for a period of five years from the 1st day of May, 1905. Address Charles M. Beers, city clerk.

Wittenberg, Wis.—Sealed bids for the construction and installation of an electric light plant here will be received until May 9 by John England, village clerk.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 13⅛@13¼c.; Lake 13¼@13⅜c.; casting, 13@13⅛c.

The stockholders of the Interborough Rapid Transit Company of New York will hold their annual meeting on May 11.

Directors of the Cincinnati Gas & Electric Company have increased the dividend one-half of 1 per cent., to 4½ per cent. per annum.

President Herbert Lloyd says the Pennsylvania Electric Vehicle Company is earning its expenses and several thousands a year in addition.

The directors of the Automatic Electric Company, Chicago, have declared the regular quarterly dividend of 2 per cent. payable May 2.

Directors of the Philadelphia Electric Company re-elected the old officers, but took no action on the proposed assessment on the stock.

The directors of the Cambridge (Mass.) Electric Light Company issue a circular to stockholders offering for subscription 1,000 shares of new stock at $140 a share.

National Carbon Company directors have declared a regular quarterly dividend of 1¾ per cent. on the preferred stock, payable May 14. Books close May 2 and reopen May 16.

Negotiations are in progress looking toward a combination of the Rochester (N. Y.) Gas & Electric Company, the Rochester Light & Power Company and the Rochester Railway Company.

Blair & Co. of New York are offering at private sale $10,000,000 of the 5 per cent. profit-sharing notes of the London Underground Electric Railway Company. The notes are offered at 96½ and interest.

Official announcement was made Friday that the Allis-Chalmers Company has decided to suspend dividends on the preferred stock. It was stated that the management does not purpose to pay dividends unless they are earned.

A man prominent in the heavy machinery trade, and whose opinions are sought after, says: "I am looking for an interesting fight between the General Electric and Westinghouse companies and the Allis-Chalmers Company for heavy electrical machinery."

It is said in Wall Street that the Metropolitan Securities Company of New York will soon avail itself of its right to issue $2,500,000 Central Crosstown bonds and $2,000,000 Third Avenue 4s for improvements. It is said that funds will be provided in that way instead of making a further assessment on the Metropolitan Securities stock.

An official of the Brooklyn Rapid Transit Company says: "Our earnings continue to grow and our summer business will be a record-breaker. B. R. T. is developing into the great property it was planned to be, and all it asks is to be let alone. It has been a Wall Street football long enough. Wall Street is not a healthy atmosphere to develop a business property."

According to the Boston *News Bureau* a General Electric interest says: "It is no use crying over spilled milk, but as a matter of fact we believe that if we had let the Stanley Electric Company alone for three months longer it would have gone into the hands of a receiver. We paid for it four times what it was worth, but owing to the exigencies of the case we necessarily had to buy this company somewhat on faith and upon the representations made to us, without making an examination such as would ordinarily have been done."

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Apr. 25
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	142⅛
Metropolitan Street Railway	112½
Metropolitan Securities	79
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	46¼
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	66
Philadelphia Traction	96
Union Traction, $17.50 paid	49⅝
Boston.	
Boston Elevated, full paid	142¼
West End Street, com	92¼
do. do. do. pref	111½
Chicago.	
City Railway	160
North Chicago	70
Union Traction, com	5¾
do. do. pref	30½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	27
do. do. pref	63
Electric Lead Reduction	⅞
Electric Vehicle, com	6
do. do. pref	9
Westinghouse, com	158
do. pref	194
General Electric	164½
Boston.	
Edison Electric Illuminating	239
General Electric	164½
Massachusetts Electric Companies, com	20
do. do. do. pref	73¾
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	150
National Carbon, com	29
do. do. pref	102
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	59
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	126½
Western Telephone Company	8
New England Telephone Company	124
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	1⅛
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88¾
Miscellaneous.	
Chicago Telephone Company	18
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	30
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

Electricity, of Course.

The World's Fair at St. Louis was opened on Saturday by President Roosevelt, in Washington, who touched a gold key which completed the electrical circuit and released the gigantic power of the great Exposition, putting in motion the 40,000 horse power machinery and the fairy-like cascades on the grounds.

Press dispatches assure us that the electrical display "could not be surpassed," which is a beautiful tribute to Prof. Goldsborough and his assistants, who will receive their just meed of praise when the electricians assemble in St. Louis.

* * *

General Electric's Annual Report.

The directors of the General Electric Company, in their annual report to the stockholders, state that the report shows net profits of $7,865,376, including royalties and profit from securities sold and after allowing for depreciation. From this amount was deducted $76,007 for interest on debentures and $1,470,098, representing the amount written off from the patents and other accounts of the Stanley Electric Company, leaving a balance of $6,319,270. The dividends paid during the year were $3,508,284, and the surplus as of December 31 last, including the amount carried over from the previous year, was $7,263,688.

On the general conditions governing the company's business, the report says:

"The disturbed financial and other unsatisfactory conditions of the past year have considerably affected your business and the percentage of profit upon business done is smaller than for the previous year; the increased price of copper, higher priced and less effective labor, large expenses in developing steam turbines, and lower selling prices have all contributed to this result."

Considerable attention is given in the report to the advantages of electricity as a motive power on railroads as compared with steam, and the interesting claim is advanced that "the popular apprehension of the 'deadly third rail,' is without foundation as regards danger to the public—there is not a recorded instance of a passenger being killed by the third rail. The reduction in the operating expenses of the Manhattan Elevated from 55.8 per cent. in 1901, when steam was in use, to 44.7 per cent. in 1903, when the motive power was electricity, is instanced as a proof of the saving secured by a change from steam to electricity. Referring to the order secured some months ago from the New York Central for 30 electric locomotives. Third Vice-President E. W. Rice says:

"We believe this order is the forerunner of many others to be placed by steam railroads."

* * *

Rapid Transit Questions.

Full details regarding the route of the new rapid transit subway for Greater New York was laid before the Rapid Transit Commissioners last week. There will shortly be a public meeting to consider the proposed plans. It is suggested that the commission proceed as early as possible to let the contract for the South Brooklyn extension, the tunnel which is to run under Fourth avenue from the Flatbush terminal to Fort Hamilton. This tunnel, the Plan and Scope Committee suggests, can be built at the same time as the Manhattan tunnel, which is to be known as the east side extension.

Now that the commission has unlimited money to spend on rapid transit it believes that both tunnels can be constructed

at the same time. The Manhattan tunnel, it is estimated, will cost about $30,000,-000, while the Brooklyn tunnel will probably not cost more than $5,000,000 to construct.

Owing to the various conditions which must be complied with, the contract for either tunnel cannot be let until at least twelve months hence.

Meantime the commission will endeavor to have several amendments to the existing rapid transit law enacted by the Legislature. They will send bills to Albany next year empowering the city to lay conduits for pipes and wires in the tunnel, and will also have introduced a measure allowing the tunnel franchise to be taxed.

Another change advocated by one of the city officials is to build the station entrances along the line of the new tunnel on private property, which is to be taken by the city for the purpose, instead of on the sidewalks.

It is sincerely to be hoped that next year the necessary legislation may be obtained for placing pipes and electric wires in the proposed tunnels. As things now are a street is no sooner made attractive than it has to be opened up to repair either a pipe or a cable conduit. This probably helps the laboring man but it certainly does not help the business enterprises that are unfortunate enough to be located along a defective pipe line. With the pipes and cables in the subway all such nuisances would be done away with.

The citizens of Manhattan will have to have a little more patience as regards the rapid transit system. It is announced that the opening has been deferred until September. The commissioners do not deem it good policy to have a formal opening of the road until it is ready for actual operation. The management of the road expects to run trains continuously beginning on the day after the formal opening.

* * *

A German Electric Railway's Earnings.

The official returns have just been issued relating to the working results for 1903 of the first electric railway which was established in Berlin, and the initial section of which was opened for traffic in February, 1902, the remaining sections being opened gradually in the same year. Thus the results for 1903, although showing satisfactory progress, are not strictly comparable to the incomplete period of nearly eleven months, during which only one portion of the railway was in operation. The line, which is known as the Elevated & Underground Electric Railway, carried 29,628,463 persons in 1903, as compared with 18,813,994 passengers in 1902, while the short level section associated with the undertaking transported an additional 2,507,649 persons, as against 1,227,010 in the preceding period. The total working receipts amounted to $954,515, and the expenses to $500,630. After providing for the interest on the bonds, which amounted to $1,950,000, and making provision for reserve and renewal funds, there remains a net profit of $287,615. It is proposed to pay a dividend at the rate of 3½ per cent. for the year on the share capital of $7,500,000. In the preceding year the railway was worked by the contractors, who guaranteed and paid 4 per cent, interest on the share capital for 1902, at the end of which the railway was transferred to the proprietary company.

* * *

Italy Needs Electrical Machinery.

Advices received by the Government at Washington are to the effect that there is room in Italy for the importation of American electrical machinery, in spite of the many existing local shops, and of the competition of Switzerland. The United States being, however, far ahead of any other country in the matter of inventions and labor-saving machinery, American machine manufacturers would undoubtedly be able to create a market in Italy for their productions, especially in the line of machinery in connection with the utilization of the great water power of Italy. Electrical traction is being developed considerably in all the provinces of Italy, as well as electric light, the use of which is constantly increasing. Electrical machinery to the value of $60,592 was shipped from the United States to Italy during the fiscal year 1903.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

R. A. Fliess, who has been associated with Mr. Edison in the development of the nickel-iron storage battery, gave a talk about this invention to the American Institute of Electrical Engineers on the evening of April 27. Mr. Fliess stated that a cell which had been run over 4,000 miles was carefully examined for any deposit of material that had been loosened from the plates. There was a perceptible, but small, amount. Mr. Fliess showed it in a bottle. When the 4,000 mile run was ended no deposit at all was found. This was a striking contrast to his observations on lead batteries. He had charged and discharged one of the latter 190 times in succession, in a laboratory, without putting it on the road in a vehicle, yet a considerable quantity of material settled in the bottom of the cells. This was exhibited to the audience. The Edison batteries just mentioned were used in automobiles on all kinds of roads, and at the end of the trials they not only were uninjured, but each had apparently a slightly greater capacity than before. "We have done our best to ruin these batteries," said Mr. Fliess, "but we have not succeeded yet."

The Canadian Electrical Association will hold its annual convention in Hamilton June 15, 16 and 17. A series of interesting papers has been arranged for.

A large deposit of molybdenum has been discovered on Badger Mountain, near Manitou, Col. The mineral is valued at $65 a pound, and is used chiefly in hardening plate.

General Greely, chief signal officer of the army, has decided to award the contract for the manufacture of about 625 miles of submarine cable to the Safety Insulated Wire & Cable Company of New York. This cable will be used to connect Sitka, Alaska, with Fort Liscum, near Valdez, on Prince William Sound. The cable will be shipped by rail from New York to Seattle, and will probably be laid during the coming summer.

In the laboratories of the National Bureau of Standards in the Palace of Electricity at the World's Fair at St. Louis are shown more than $50,000 worth of instruments for testing every kind of electrical machine and apparatus. Several Government experts are conducting tests and investigations in the exhibit space of 23 by 200 feet. In order to overcome the effect of warm weather on the instruments an expensive refrigerating plant will be installed, as warm weather produces a moist surface on the delicate instruments. The plant will dry the air. The testing instruments will be of use in making complete records and also for aiding juries in making their awards.

The New York State Civil Service Commission, among examinations to be held May 21, will include positions for electrical engineers in State hospitals and institutions. Application must be made to the chief examiner, C. S. Fowler, Albany, before May 16.

CENTRAL STATION ECONOMY.*

BY F. H. DAVIES.

When one considers that in the average well-managed electricity works only about one-twentieth of the heat energy liberated by the combustion of coal is delivered in the shape of electrical energy at the dynamo terminals, it is obvious that there is plenty of room for improvement in methods of generation. But practical experience shows that if this tremendous loss is to be reduced to any appreciable extent, these methods must be of an entirely new character, and must not require the present numerous transformations of energy that necessarily produce uneconomical results. This fact has been recognized for some time, and many efforts have been made to bring about a more satisfactory state of affairs by the production of electricity direct from coal, thus eliminating those factors that are responsible for the waste—viz., boilers, steam pipes, engines and dynamos. Whether this Utopian idea will ever take practical shape remains to be seen; at the present time the outlook is hardly hopeful, and we have no alternative but to proceed along the stereotyped, and from the point of view of transformation of energy, extremely inefficient lines.

There are, however, many little economies that may be effected in central station practice, which, although small in themselves, mount up considerably in the long run. The means of securing these economies will generally suggest themselves when it is ascertained where the loss is taking place, but in connection with this the chief thing is to know where to look for it. A case in point is that of wet coal. Very frequently, when coal is brought to the works by barge, it arrives in a more or less sodden state at the bottom of the load, and as this portion is naturally on top when stored into the bunkers, a great part of the water percolates into the heap and damps it right through, with the result that its efficiency as a heat producer is greatly diminished. It is astonishing what a long time a heap of damp small coal takes to dry even when exposed to sunshine or a high temperature, in the boiler house. The surface naturally dries quickly, but a few inches down moisture will be found even after weeks of storing in a dry place. The obvious remedy is continually turning the coal and spreading it over as large a surface as possible, but this necessitates bunkers of very ample proportions, such as are not usually found. The prevailing impression seems to be that coal can be stored anywhere and anyhow, and many do not appear to be alive to the fact that "weather" has a very bad effect on its calorific properties. The ideal coal bunker should be spacious and well ventilated, and, if possible, placed in such a position as to allow of a glass roof, and the consequent drying action of the sun. Coal stored in such bunkers has a fair chance of drying, that in the usual gloomy dungeon of the domestic coal-cellar variety it does not get. This seems but a small point, but it is one that should not be neglected, as those who have gone into the question practically well know. Of course, where coal is very small and dusty the addition of a little water is necessary, in order to keep it from being carried into the flues, unconsumed, by the draught.

Bad stoking is a very prolific source of waste, and whether it is performed by hand or machinery, there are few engineers who can be certain that they are getting the full value out of the coal consumed. It is well known, of course, that the grate should be uniformly covered, and only sufficient air admitted to insure perfect combustion and the minimum amount of smoke. It is, however, only too common to find bare patches on the bars, especially where mechanical stokers are used, or, rather, misused. With those of the coking type with movable grates, a common mistake in working is that of allowing the fuel to burn completely away before it reaches the back of the furnace, the consequence of which is that the hinder part of the bars are only covered with clinker, and so let through air in large quantities, thereby reducing the efficiency considerably. It is by far better practice to so adjust the speed of the bars that the fuel falls over the back partially consumed; it can always be burnt over again mixed with fresh coal, or if allowed to remain in the ash pit, will efficiently finish its combustion there. Another alternative is to work with a thicker fire, which naturally takes longer to burn away, but this course is not always possible, as the thickness of fire must to a certain extent depend upon the nature of the coal and conditions of load and draught. Good stoking is naturally the outcome of experience that dictates what must be done under varying conditions, and it must not be thought that even the best mechanical stoker can be efficiently worked by an unskilled man; if anything, the reverse is the case.

The banking of fires in standing boilers is another operation that frequently gives rise to loss, and in connection with this it is most essential that the coal should be well damped and heaped, and that the dampers should be efficient—that is to say, not leaky.

The brickwork settings of water-tube boilers need most careful erection and watching, as the air leakage that is continually taking place through the pores of the bricks and their joints is very deleterious to efficiency. The layers of fireclay mortar between the courses should be as thin as possible, and the bricks should always be of the glazed variety. Cracks, which are bound to occur in time, should be thoroughly stopped up directly they appear, and holes in the brickwork through which blow-down and other pipes emerge should be carefully filled up or covered, not with cement, as this is liable to cause damage to the pipes, but with a dab of boiler lagging or a wooden or iron cover. This trouble of air leakage is so serious and difficult to overcome that in places it has been found necessary to completely cover in the boiler and brickwork with a thin sheet-iron casing. Well-built glazed brickwork will, however, generally solve the problem, or where ordinary bricks are used, a good coating of tar will considerably reduce the leakage.

Perhaps the greatest source of waste in boiler-house plant is the old-fashioned steam feed pump that carries steam along the full length of the stroke. This fact has long been recognized, but, strange to say, this type of pump is still installed on the score of its supposed cheapness, which is an utter fallacy. The modern expansive steam-pump is very little, if any, dearer in first cost, and will certainly save the extra amount if it exists, in a few months in steam consumption alone, putting aside repairs and renewels, which are comparatively low in this type of pump. The so-called cheap pump is also frequently very wasteful on the water side, owing to its plunger letting by, thus producing a churning motion that absorbs a great deal of power. The water pistons of these pumps should be frequently examined, and if it is noticed that a higher speed than usual is necessary to perform the same work, they should be repacked at once, as this is a sure sign of letting by. Apropos of this, it is always advisable to thoroughly overhaul pumps of this kind before setting to work for the first time. In a station with which the writer was connected some cheap American feed pumps were installed. They were sent down as ready for running, and were started up hurriedly without examination. One of them answered satisfactorily for a year, and then gave signs of being unable to do its work. Upon overhauling it was found that the

*From the "Electrical Engineer," London.

water piston had never been packed; the space for the fibrous packing was empty, and the pump had been running, strange to say, satisfactorily on the two gunmetal ends of the plunger. This was doubtless due to a very exceptional piece of American workmanship, as at the start the piston itself had evidently been a perfect fit. The above is given as an instance of the care that must be exercised in the installation of plant of this class, and that in the interests of efficiency it does not do to take anything upon trust when dealing with it.

Feed water in many installations accounts for a good portion of the works' costs, and is frequently the source of waste. In most cases, if a boiler has to be repaired or cleaned, it is blown right down into the sump and all the water thus lost, but this is not at all necesary if the blowing-down arrangements are properly designed and used. There should be a main blow-down pipe, into which all the boiler branches lead, having a valve in it between the last boiler and the sump. When a boiler is to be emptied the main valve should first be shut, the valve in the blow-down pipe of an empty boiler and its safety valve opened, and the boiler then blown down. This will result in the saving of practically 50 per cent. of the water, as this amount will naturally flow into the empty boiler before the water levels become even. The other 50 per cent. must be lost, but the saving is considerable, especially when large boilers are used.

The losses that occur in steam-pipe work account for a large proportion of the total. They are due to four causes—leaky joints, long runs, bad covering and inefficient steam traps. Persistently leaky joints cannot be cured except by some structural alteration in the piping. Practical experience proves that, although some jointing materials are better than others, the best will not cure a defect arising from bad workmanship, and for this reason it is imperative that pipework should be of the best quality and erected in the most careful manner possible, with due provision for staying and expansion. The causes of leaky joints are badly faced flanges, pipework that being too short has had to be pulled together on the last joint, inefficient expansion and draining apparatus. If flanges are badly faced, or do not meet truly all around, the cure is obvious—they must be faced up properly; experiments with jointing materials are waste of time and money. If the work has been pulled together in a straight length where there is no allowance for expansion, there are two remedies open—either to provide an expansion bend or joint, which is costly, or, preferably to insert a carefully shaped and faced distance piece between the two open flanges. Should a certain length of pipe persistently give trouble with all or several of its joints, this points generally to expansion or water troubles, and should be carefully investigated; it may be that the staying is too tight and does not allow the contraction and expansion to be taken up on bends, as is generally the case. If this is so, an expansion piece must be inserted, preferably a U-shaped piece, not a joint, as the latter always leak. This will be found, in the long run, the cheapest remedy.

Should the trouble be located as due to water, it means that the draining arrangements are inefficient or not properly used, and the best way to set about a cure will probably be to install an extra drain pipe at some low part of the range, or to overhaul the steam traps. These latter are often very troublesome chiefly owing to inattention. They are too frequently stowed away in practically inaccessible places, and there left to chance their luck, year in and year out, with little or no inspection. If such is the case, they are bound to become in time either useless or wastful—that is to say, they will either not let anything through them or will go too much the other way and pass steam and water indiscriminately. Traps should be in sight, above the floor level, and under constant observation; if placed like this, leaking and waste or refusal to work is bound to be noticed at once.

Condensation losses through long runs of pipe can only be minimized by judicious manipulation of the section valves, allowing only just as much pipe to be alive as is commensurate with convenience and safety. This in some large stations has been reduced almost to a fine art, and there is no getting away from the fact that the amount of thought and organization necessary is amply repaid by the increase in efficiency. In a large station with a dozen or more boilers, and perhaps as many steam sets, the efficient working of the pipe range is by no means a simple matter, the economic possibilities, of course, depending greatly upon the style of arrangement. The only way to secure maximum economy is to work upon a system—that is to say, as far as practicable, certain engines should be run when certain boilers are in service, taking care that the steam way is the shortest possible between the two. In a small station, or with a simple straightforward arrangement of piping, there is not much in it, but with some of the old-fashioned elaborate ring or duplicate systems that are fortunately dying out, the possibilities are immense.

Much has been said about pipe and boiler coverings, particularly by manufacturers. It is therefore only necessary to reiterate that to allow even the smallest portion of steam-piping to go inefficiently covered or entirely bare, is simply throwing money away. Condensation tests on covered and uncovered pipe are frequently quoted, and the writer would commend their perusal to engineers who do not appreciate the enormous losses entailed by bad lagging.

In all well-managed stations the engines are indicated at frequent intervals—a very necessary precaution, from the neglect of inefficiency often arises. The comparative economy of engines, of course, depends chiefly upon their design and building, and cannot be improved unless drastic structural alterations are made, but it is necessary to guard against the minor losses that occur through wrongly set valves, leaky joints, glands, etc., and the frequent use of the indicator is the only way to check the first and most important of these. It is not sufficient to take cards and so get an indication of the general action of the steam in the cylinders—they should be worked out in order to ascertain whether the work is evenly distributed; if it is not, an uneven turning moment is the result, and unequal wearing of the brasses. This, when very bad, has often been the cause of persistent hot bearings on one side of the engine, and consequent expense and trouble in repairs, that by an intelligent use of the indicator might have been entirely obviated. The glands of inclosed engines when covered in naturally do not, as a rule, receive as much attention as those of the open type; they are, however, apt to be just as troublesome. The surest indication of their leaking is excess of water in the crank chamber, and if the amount of this is systematically observed, a certain check can be kept upon their condition.

In all stations during the heavy load it is necessary to keep a certain amount of plant in a condition to be put to work at the shortest notice. From the point of view of economy this is a very important point, indeed, and a great deal of experience is necessary to say when the expense of keeping spare plant turning over or warmed up is exactly counterbalanced by the increased safety. The primary considerations are, of course, the condition of all or any one of the running sets or boilers, as regards freedom from breakdown, the amount and nature of the load,

and whether rising or falling; upon these, again, is imposed what may be termed the component of local conditions, and the whole makes a very pretty problem for each individual station engineer.

To tackle the question from the commencement, boiler stand-bys, in anything but the very largest stations, are practically unnecessary—that is to say, if the boilers are well looked after; there may be a little risk in this, but the expense of getting up steam in a spare boiler every day, only to let it down again, is in most cases prohibitive. In a small station, therefore, there is but little choice in the matter—so many boilers will be required for the peak of the load, and so many must be steamed. Until the maximum is reached, and after it, there is plenty of stand-by, the only risk taken is at the peak, and as this is not as a rule on for long, it is worth running. In a large station, however, things may be rather different; the expense of steaming up a spare boiler or two is proportionately small, and the usual procedure, therefore, is to use more than enough boilers for the work, thus having something in hand in the event of breakdown. As it does not pay to force boilers, this method, besides being safe, is perhaps economical, and its use in small installations is only debarred by the proportionately large cost of raising steam and banking fires.

It is on a rising load that stand-by engines are chiefly required; when the load is falling, this precaution, is, in most cases, not so necessary. It all, however, depends upon conditions, such as the size of the sets, and whether they can be run up to speed quickly. If they are small, and of the high-speed inclosed type, warming up is generally sufficient to meet all the requirements of safety, as such engines can be got up to full speed from standing in a few seconds; but with heavy plant the case is different, and unless the spare set can be run up to speed and ready for taking load, say, in about 30 seconds, it is necessary to keep it turning over. This, of course, entails unprofitable use of steam—that is to say, unprofitable, inasmuch as it does not go towards the generation of current—but it is a highly necessary precaution, and on a rising load the loss is scarcely to be begrudged, seeing that the spare set will probably go into parallel very shortly. In the case of a fog load, questions of economy in this direction must, of course, be thrown to the winds; but in dealing with the ordinary evening load, with its predetermined value at certain times, a system based upon observations and energetically carried out, will do much to reduce what is sometimes the very considerable loss entailed by the keeping ready of stand-by plant.

THE LATEST PROGRESS IN WIRELESS TELEGRAPHY.

BY EMILE GUARINI.

Translated for "Electricity" by Jean A. Wetmore, M. S., E. E.

(*Continued from page 234.*)

The time seems to have arrived for us to point out a device, which appears to us as having the same advantages as the Fessenden device and which eliminates its disadvantages. It is known that when the transmitter is not grounded the transmission distances are much less than when it is grounded; it is then only necessary to have the transmitter operate constantly and to insert a key in the ground circuit, the receiver being then effected when the ground circuit is formed.

Speaking of receivers, M. Ferrie recalled the Marconi "magneticum detector" (Fig. 13). In this detector there

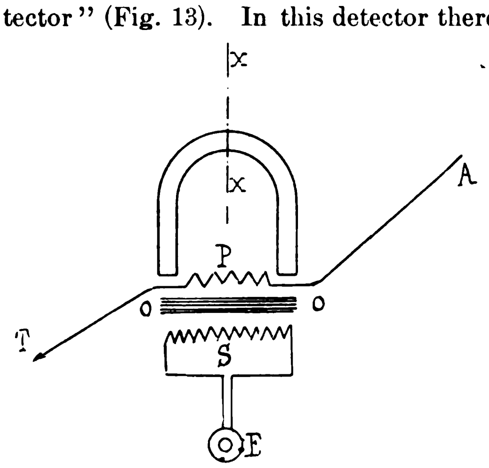


FIG. 13.

is a core, O, composed of iron wire, on which are mounted two superimposed circuits. One of them, P, is made up of a short length of copper wire, which is connected to the antenna and to earth. The second winding, S, which is much longer, is connected to a telephonic receiver, E. Fronting the sides of the core extremities are placed the poles of an iron horseshoe magnet, which turns about its axis, X, at a speed of about one revolution in two seconds. The magnetization of the core is consequently constantly varying.

The variations in magnetism resulting from the action of the oscillations passing through the circuit, P, set up induced currents, which effect the telephone, E; the signals received are thus read by sound. This detector has the advantage over a coherer, in that it does not require adjusting and is perfectly uniform in its operation, but it is not as yet demonstrated that its sensitivity is as great.

For those who are interested in the history we will mention that this device is, as a whole, a deviation from the device on which we were the first to experiment, and which was later used by Ruhmer from 1900 to 1901, in which there was an antenna connected to earth across the primary of an induction coil, of which the large wire of the secondary (the trans-

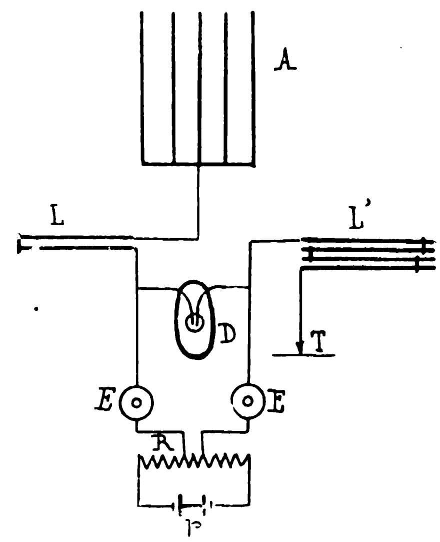


FIG. 14.

former transformed the Hertzian waves at low tension) contained a telephone, having its core magnetized by the Hertzian waves. Marconi added thereto the property discovered by Rutherford, and now the telephone is used as a receiver in those systems which produce long lengths of waves, especially those in which the two effects predominate.

The speaker further stated that Mr. Fessenden has been able to construct bolometers during almost two years (Fig. 14), which have a sensitiveness, we are told, favorably comparable with the best coherer, and having the same advantages over them as the Marconi detectors.

In Fig. 14 D is a glass bulb, A is the antenna, T the ground, LL^1 the harmonizing device, E the telephone receivers, R the resistance of the potentiometer. The antenna is tuned up by shifting the plates LL^1. M. Ferrie states that he has no information regarding the results obtained by this procedure, but this has undoubtedly escaped his memory, for the Fessenden device has been experimented with and has given satisfactory results.

M. Rochefort has recently proposed the device, referred to later on (Fig. 15), by using the ordinary coherer as a wave detector. The antenna is grounded through several coils of the bipolar resonator U. When the number of coils and their lengths are properly selected the

resonator will vibrate in unison with the antenna, and two maximums of equal tension and opposite polarities will be produced at the extremities, the coherer being connected to it, but for the purpose of doing away with the use of condensers, so as to prevent the battery from being short-circuited by the resonator, the coherer has three terminals, i.e., is made up of two coherers in series. The relay battery circuit is connected to the central portion of the coherer and thence to ground.

M. Ferrie then opened up the discussion, and stated that every one makes use of the electric spark for the purpose of obtaining high period electric waves, and as a result the oscillations cannot help but be deadened.

We have proven that electric waves of very low frequency suffice for wireless telegraph purposes. This is easily explained when we consider that the phenomenon of wireless telegraphy is particularly based on conduction through the

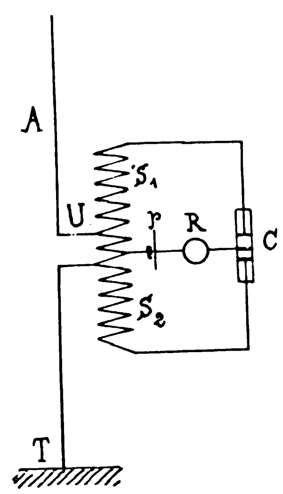


FIG. 15.

earth, or through the sea, and likewise through the atmosphere. Furthermore, it remains to be theoretically proven why Hertzian waves of high frequency should produce better effects than low frequency waves. An observation is to be noted in regard hereto. In the Hertzian waves the energy employed during a definite period is subdivided into a very large number of waves, whilst in a low frequency current the same energy is divided into a number of much smaller waves, consequently these waves are of a much greater energy and they can carry much further. From trials, unfortunately over a short distance, we have proven, by employing a telephone as a receiver, that our way of looking at the matter is correct.

All the proposed devices for transmission can, according to M. Ferrie, be classed under one of the three following types:

First—Directly excited apparatus (Fig. 16), in which the antenna and the earth take the place of a condenser for utilizing the discharge.

Second—Apparatus excited by induction, such as the Braun (Fig. 17). The

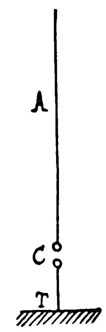


FIG. 16.

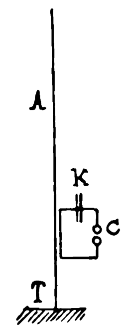


FIG. 17.

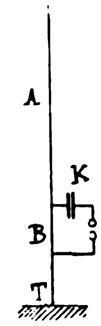


FIG. 18.

exciting oscillations are produced in a closed circuit, KC, and act immediately upon the antenna, A, the capacity, K, being so chosen as to harmonize with the period of the antenna itself and with that of the excitation.

Third—Apparatus using excitation by derivation, such as the Slaby (Fig. 18). The antenna is simply placed in shunt upon the exciting circuit, it still being necessary to harmonize the exciting period with that of the antenna.

Concerning the utilization of the energy expended for the charge the first type is the best, as it does not admit of any losses through induction or through derivation. We will also add that it is the best because the energy is spent almost as a whole by the first oscillation.

The third type appears the least good, as it allows of vexatious losses of energy arising from the production of two species of oscillations, although only one of them is taken up by the receiver. The first kind of oscillations are those pertaining to the antenna, ABT, and the others are those of the circuit, AKCT.

On the other hand, the first type produces oscillations which are much more deadened, for really the loss by radiation in this case absorbs all the energy, whilst in the other system there is only a partial loss of the total energy produced.

In the first type each discharge in reality gives only one oscillation, which is very energetic, acting upon the receiving circuit like a percussion; and this oscillation, nevertheless, appears to furnish a well determined and constant period, in spite of observations to the contrary, when a single antenna is used, and its effect upon the receiving circuits is at a maximum when both have exactly the same period.

It appears appropriate at this point to recall to mind that for a long time past Mr. Marconi has proven that even by direct transmission it is possible, even to a limited extent it is true, to prevent disturbances between stations having antenna of quite varying lengths.

(To be continued.)

ELECTRICAL STATION PRACTICE.

ARTICLE XXXV.

BY W. H. RADCLIFFE.

Although man possesses no specialized sense for the detection of electrical forces, it has been proved that each of the five special senses he does possess, namely—seeing, hearing, smelling, tasting and feeling, can be effected by a current of electricity. Ritter, for example discovered that the passage of a weak current through the eyeball caused the optic nerve to produce the sensation of a bright flash of light. So minute is the current necessary to produce this effect, that similar results may be obtained from a battery cell formed by placing a strip of metal under the tongue and bringing it in contact with another strip of metal touched to the moist tissue of the eye. Volta found that musical sounds were produced in the head when a current of electricity was passed through the ears; Humboldt discovered that the passing of a current from the nostril to the soft palate caused a perceptible odor, and Sulzer first detected a peculiar taste when two dissimilar metals placed upon the tongue were brought in contact with each other. It requires neither a Ritter, a Volta, a Humboldt, or a Sulzer, however, to prove to the average station attendant that the sense of feeling is readily affected by a current of electricity. The sensation thus experienced under direct current pressures up to 100 volts is of a prickling nature, seemingly centered at the joints; at 100 volts the sensation becomes rather painful and is accompanied with an involuntary contraction of the muscles. At 200 volts the sensation is intensified, but the degree of painfulness varies with different persons.

Persons of a weakly or nervous constitution, or those who suffer from damp hands, are much more susceptible to electric shocks than are strong healthy persons having comparatively dry skin. A man whose constitution is of the former type cannot generally endure more than 60 volts direct current from hand to hand without painful sensations, while a person of the latter type can usually stand 200 volts or more. The shock received from an alternating current is more severe than one of equal voltage received from a

direct current, and the results are also more fatal. A pressure of 50 volts direct current, for instance, will not usually cause unpleasant sensations, but under the same conditions a pressure of 25 volts alternating current will be found very disagreeable. It is well, therefore, to exercise proportional care when working with these two different forms of electricity.

Under ordinary conditions the resistance of the human body is about 2,500 ohms, the greater portion of this resistance is caused by the skin, which if perfectly dry has a resistance of 100,000 ohms. It is obvious, therefore, that the condition of the skin is the determining factor regarding the seriousness of a given pressure below 200 volts. As accidental contacts with live conductors in a station generally occur about the hands and arms where the skin is dry and hard, no serious results need be anticipated from pressures of 200 volts or less. When dealing with ordinary working pressures above 200 volts, however, it is necessary to exercise care in proportion to the increase of the working voltage above this amount, and this is especially true where alternating currents are employed.

It may be well to emphasize the fact that it is not the electromotive force or voltage that produces death. The voltage is, of course, directly responsible for the current, but it is the current alone that is the direct cause of fatalities. It has been ascertained at official electrocutions that it is necessary to pass less than one ampere (about .8 ampere) of current through the vital portion of a human body in order to cause death. It has already been stated that proportional care should be observed when dealing with ordinary working pressure above 200 volts. When alternating currents of higher than the ordinary working pressures are considered, such as 100,000 volts or more, there is really less danger to life than with alternating currents of normal pressures. This is due to the higher frequencies which accompany the higher voltages, and which tend to greatly increase the internal resistance of the body; subjected thereto the resulting current is thereby forced to the outside and passes harmlessly over the surface of the skin.

Electrical shocks are seldom beneficial to the system unless administered modererately and they be under complete control. Accidental shocks are therefore to be avoided under all circumstances, and it is possible to do so if all connections be made before the current is switched on the circuits. Use should therefore be made of the main switch in each circuit requiring repairs or alterations, opening the same whenever work of this nature is to be done and closing it upon completion of the task. The conductors will therefore be entirely disconnected from the supply circuit and consequently dead, while undergoing repairs or alterations, and accidental shocks will be entirely avoided. In cases where the interruption of service caused by the opening of the main switch would be of a serious nature, it is necessary to work upon live wires. While this task is not an enviable one at best, the danger associated therewith may be reduced to a minimum by following a simple rule. This rule is, when working on one conductor, avoid coming in personal contact with any portion of the circuit at a different potential from this conductor. Rubber gloves, rubber shoes, or both, may be used for this purpose; if, however, these articles be not provided, it is advisable to stand on dry wood and work with one hand as much as possible. Working with one hand reduces the chances of the other hand breaking the rule previously given, in which case the current would pass directly through the body from side to side. As there is always an inclination from force of habit to use both hands simultaneously, it is best to keep the unemployed hand in the pocket in order to make sure not to use it.

When working on high potential circuits carrying alternating current, it is necessary to be ever on guard, not only to avoid coming in personal contact with live conductors but also to protect one's self from leakage of the current, which latter feature is often excessive in installations of this nature. The best of insulation often fails to prevent leakage from high voltage alternating current conductors, and they should not be touched unless one is standing on a thoroughly insulated support and protected with all the safety appliances known to the art. In mentioning safety appliances, reference is here made to rubber gloves, rubber shoes, and tools provided with rubber-insulated handles. If the precautions previously given are carefully followed, the dangers associated with electricity will be reduced to a minimum. It has, however, been said that familiarity breeds contempt, and an inspection of statistics shows this to be the case regarding electrical fatalities of an accidental nature. Practically all persons who have been killed in this manner have been expert stationmen and linemen who, through long acquaintance with dangerous currents, have become careless in observing the simple precautions already presented in this article.

As to the sensations experienced by one receiving a fatal electrical shock, it may be stated there does not appear to be an instantaneous loss of consciousness, that is, consciousness is not lost synchronously with the beginning of the shock, and death does not instantly follow, although it may be said to supervene with great rapidity. The period of consciousness, although extremely brief, seems to be sufficient duration for the victim to perceive that an electric current is passing through him, and this sensation, though indescribably unpleasant, seems to be comparatively painless. The effect of a fatal current on a human body is as follows: It primarily effects the nervous system, causing spasms, after which it destroys the tissues by burning or by electrolytic action, coagulating the blood. The conditions are such that the same restoratives used in reviving drowned persons should be employed in resuscitating victims of electrical shocks. The object in all cases is to create a circulation of the blood, and this requires prompt and continued efforts if successful results are to be obtained. Accidental shocks very rarely terminate fatally unless the victim is left unaided for too long a time, or attempts at reviving him are stopped too soon.

The method of procedure for resuscitating victims of electrical shocks from apparent death is as follows: The first step should be the removal of the body from contact with the current-carrying conductors. In doing this it is necessary to protect one's self from a similar fate by using some insulator, such as a dry stick of wood, to separate the wire from the body or the body from the wire. When rubber gloves are worn the separation can much more readily be accomplished for then there is no danger in touching the body of the victim. If rubber gloves are not conveniently near, and it be found necessary to employ the hands, a dry piece of cloth or clothing may then be used to protect them in place of rubber gloves. In case the body is in contact with the earth, the separation can usually be affected by grasping some part of the clothing on the victim and by means of this pulling him to a place of safety.

The rescue having been accomplished by employing one of the methods previously suggested, the body is placed upon the ground, back down. In order that the conditions may be favorable for reviving the victim, in other words, establishing respiration or breathing, it is necessary to have the collar and clothing about his neck loosened and his head well thrown back. By rolling up a coat and placing it under the shoulders a proper

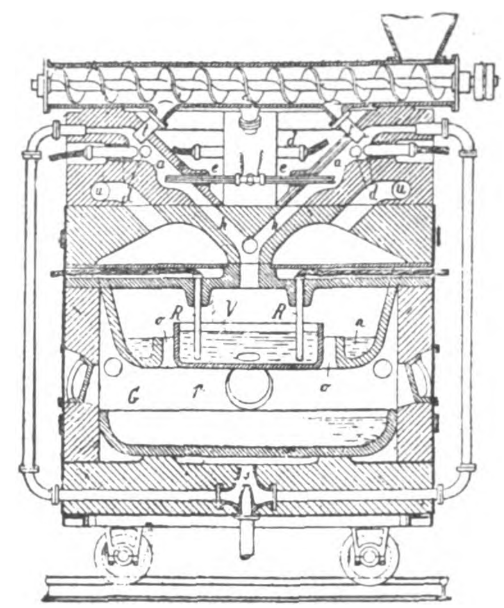
inclination of the head can be readily obtained. This having been done strenuous efforts must be made to induce breathing. To accomplish this in the most effective manner requires the services of two persons, one kneeling at the head of the victim for working his arms, and the other stationed near the center of his body for manipulating his tongue. The party kneeling at the head should grasp the arms of the victim and draw them to full length over the head, keeping them quite closely together. This movement tends to expand the chest and permits air to enter the lungs. The arms should be held extended in this manner for about two seconds and then pushed down to the sides and front of the chest, compressing them thereon. This latter movement tends to force the air out from the lungs. After the arms have been held upon the chest for about two seconds, they should again be extended over the head to full length as already explained. This complete cycle should be repeated at least sixteen times per minute for half an hour, or until natural respiration is established.

Simultaneous with the movements just explained, the party manipulating the tongue of the victim should quickly draw it out of his mouth to the limit, when his arms are being extended above the head, and permit it to return to its normal position when the arms are compressed upon the chest. The object in this movement of the tongue is twofold; when withdrawn, the throat is cleared so as to afford a free passage for the air to enter the lungs, and at the same time the friction between the lower part of the tongue and the lower teeth tends to induce an involuntary effort at breathing. As in the case of the arm movement, the motion of the tongue should be repeated at least sixteen times per minute for half an hour, or until natural respiration is established. In order to obtain a firm grasp upon the tongue, it will be found necessary to place in the hand a piece of cloth or a handkerchief so as to prevent it from slipping. If there is difficulty in reaching the tongue, owing to the jaws being clenched, there should be no hesitancy it forcing it open either with the handle of a knife, a stick of wood or any article that will answer the purpose.

In addition to the preceding directions, the application of ice to the spine, the dashing of cold water in the face, and the alternate application of cold and heat over the heart has a tendency to start the breathing apparatus. Oxygen gas, if obtainable from a nearby drug store, may also be advantageously employed during the previously described movement of the arms. The best method of applying it consists in forming a piece of stiff paper into a cone and placing the larger opening over the mouth and nose of the victim, while the smaller opening is attached to the tube leading from the oxygen tank. If the oxygen gas can be thus induced into the lungs, it will act with good effect as a stimulant upon the heart. Under no circumstances, however, should liquid stimulants be poured down the throat, as such a practice in a case of this kind is not only of no benefit, but is on the other hand distinctly injudicious.

AN ELECTRIC GLASS FURNACE.

Electric furnaces are giving good results at the large glass factories at Matrei, in Tyrol, and at Plettenburg, in Westphalia. The accompanying illustration



shows the tubes, *t t*, through which the raw material enters the top of the furnace, whence it is conducted in front of the arcs, *a a*. The heat of the arc fuses the material, which then drops into the receptacle, *V*, where its temperature is considerably raised by the resistances, *R*. From *V* the molten glass, of its own accord, descends into the crucible, *G*, which is heated by an upward flame, *P*. The latter is formed by the gas which is developed during the fusion of the material. This gas is collected and conducted to *P* by means of the lateral tubes, *r*. Although this furnace has given satisfactory results a new type has been constructed in which the raw material, before having been exposed to the heat of the arc, is made into a paste with water. It is then pressed and dried, and finally it passes, in the shape of a ribbon, through the arcs between a number of electrodes, out of which it emerges completely fused. The heating is chiefly done by radiation, and care is taken to prevent impurities from the carbon entering the molten glass.—*Electrical Engineer, London.*

ELECTROLYSIS.

The following interesting communication was sent by Mr. H. W. Spang to the Brooklyn *Eagle:*

In my letter in your issue of April 19, in reference to electrolysis in Brooklyn, I asserted that in every case investigated by me the path of the traction current between an electric railway and water, or vice versa, was clearly defined.

It is owing to the fact that the true action of the current of the overhead trolley railway has never been thoroughly investigated by electric railway engineers that the introduction of the proper remedy for electrolysis has been delayed.

The average electric railway engineer apparently cannot comprehend why a traction current should leave a circuit with a good metallic return, such as a pair of track rails, provided with the most improved fish plates and copper bonds, and even with a supplemental copper or other metal return conductor. It, nevertheless, does escape, as is testified to by twenty experts in the Dayton, O., electrolysis case, and as experienced in every city and town where the grounding conditions are favorable.

Electric engineers have blundered in determining the requirements for electricity in a working circuit by the comparative conductivity of copper and water as tested in the laboratory. Most electricians imagine that water is a poor conductor of electricity, being governed by the statement in the electrical text-books that pure water is a non-conductor, which refers to a small quantity of distilled water in a tumbler, subjected to the ordinary galvanometer or conductivity test in a laboratory.

I have found that when the water (fresh or salt) of a swamp, creek, river or other waterway is properly utilized it is an excellent conductor of low or high potential electricity.

There is an erroneous impression that the current from the positive pole of a generator flowing to earth or water at one or more points returns through the earth or water to the negative pole. It does nothing of the kind. It simply causes a corresponding current flow from a suitable area of earth or water to the negative pole.

The radiating nature of electricity is revealed in wireless telegraphy. It does not return to its source.

Electrical research has principally been

confined to the laboratory, which has resulted in the rapid development of electric generators, motors and other electrical apparatus. In fact, the advance in electric generation has been far more rapid than the determination of the means for afely employing powerful electric energy, which can only be ascertained through a thorough investigation of the action of electricity in a working circuit and not in a laboratory.

It is about time that the laboratory be altogether ignored in the determination of lightning protection requirements. The ordinary lightning rods and the usual devices employed with electrical circuits cannot afford protection from lightning discharges or intense induced electric charges.

Absolute lightning protection can only be effected by a proper system, based upon true scientific principles. The number of lightning fires in this country have increased from 625, with a loss of $1,618,-539 in 1890, to 3,440, with a loss of $5,272,835 in 1900. During the eleven years, 1890-1900, 588 churches, 10,742 barns and 5,907 other buildings, mostly in the suburban sections, were ignited by lightning, with a loss of $30,611,284. There were also many cases of shattered churches and buildings without being ignited.

In addition to the eleven year period of sun-spot maxima, astronomers claim that at intervals of about 33 to 35 years there is also extraordinary solar activity, attended with great eruptions or protuberances on the sun, extending in some cases to a height of about 300,000 miles, and accompanied with numerous auroras, magnetic storms and the most terrific thunder storms upon the earth.

Such excessive solar activity and phenomena last occurred during the three years, 1870-72, and during thunder storms on August 14, 15 and 16, 1872, the induced electrification of the earth was so intense in some sections that railway trains while running were surrounded by a vivid light and the fusion of lengths of telegraph wires and the destruction of poles and telegraph apparatus and igniting of telegraph offices, especially in suburban sections, was general. During the said three days over 200 dwellings and a large number of barns in New York State and the New England States alone were ignited or otherwise damaged.

There was no telephone, electric light or trolley railway wires during that year, and it is somewhat with misgivings that we can look forward to the next three summers, especially in view of the fact that under the present electric engineering practice lightning discharges are encouraged to take place in line with overhead telephone, electric light and trolley railway wires and enter buildings and cars and destroy or damage them, regardless of the arresters, choke coils and safety fuses employed with such circuits.

ELECTRICAL EQUIPMENT OF A CANAL.*

BY F. H. LEONARD, JR.

(*Concluded from page 235.*)

LOCK HOUSES.

At the upper end of each lock on the south bank there is located a small switchboard cabin, 7 feet x 9 feet; on the little island between the two locks is located another switchboard cabin and at the upper end of the lock on the north side of the second lock is another cabin. In the first of those above mentioned are placed three transformers and connecting to the 11,000 volt mains, which step voltage from the line pressure to 550 volts, and it is at this pressure that the motors operate. A high tension fuse board is provided to take care of the primary connections to the transformers. The long inclosed fuse has friction contacts at either end and by pulling these fuses out of the end clips by means of a wooden stick with a hook at the end, the circuit can be opened in case of temporary trouble, or for any purpose whenever it becomes necessary to disconnect the transformers. The secondary of the transformers passes through the switch on the switchboards which distribute the secondary current to the motors, two of which are located on each side of the lock. Armored cable with paper insulation is used to conduct the current from the switch cabin to the motors located on the same side of the lock.

The connection for motors on the opposite side is carried through armored cable which leads down through the floor of the switch cabin and passes through a hole drilled in the stone coping of the lock to the upper stop log check; there being two checks cut in the masonry, this leaves one which could be utililized for stop logs in case it ever became necessary to keep the water out of the lock during repairs. The cable turns over a radius of 16 inches at the top and passes down the check, being protected by a piece of oak plank which is grooved in the center to take the cable, the plank being fastened by drift bolts to the stone work and protected at the edges with iron strips. As the plank does not come above the edges of the check in the stone work there is practically no danger of the cables ever being injured by a boat in entering or leaving the locks.

Where the cable crosses on the lock bottom a timber is held on top grooved on the bottom side to receive the cable, and as the top of this timber is well below the breast wall at the entrance of the lock there is no danger of the cable ever being disturbed.

Rising on the opposite side of the lock in the stop lock check, the cable again passes through a hole drilled in the stone coping until it comes out of the earth back of the masonry under the next switch cabin; from this switch cabin the cable is carried into the third switch cabin on the north side of the old locks.

You will bear in mind that the new locks were built on the south side of the old locks and are about 70 feet longer, the old locks being 55 feet wide and 200 feet long inside the gates and the new locks 45 feet wide and 270 feet long inside the gates and 14 feet over sills.

On the switchboards in each of the cabins are placed the motor starting switches connected to auto starters which control the motors on one side of each lock. From the switch cabin on the south side are operated two motors, the first motor being connected by armored cable reaching from the switch cabin underground to the first motor. The second motor is reached by conductors running from the switch cabin overhead to a pole very near the motor at the lower end of the lock—armored cable connecting from the pole underground as far as the masonry and checked into the masonry where it passes over to the motor.

The switch cabin on the little island between the two locks controls the two motors on the north side of the new locks and two motors on the south side of the old locks. The third switch cabin controls the motors on the north side of the old locks, as well as the motor operating the weir gate mechanism.

The arrangement is identical in all the locks with the exception of No. 15 and old lock 16, which are not provided with weir gates. The equipment for operating the lock gates and weirs was adapted for use in connection with the winches and weir gate mechanism already installed without disturbing their capability for hand operation should occasion require. When these devices were operated by hand, the lockmen laboriously turned a crank on the winches at the two opposite sides of the lock gates, utilizing one winch for opening and the other for closing the

*Abstract of paper read before the Electrical Section of the Canadian Society of Civil Engineers, Montreal.

gates. Four winches were located at each end of the lock, two on each side, one of which handled the chain to close the opposite gate, the other to open the gate on the side at which these winches were located. Across the top of each gate is a bridge on which is mounted the worms and rods for opening the two valves in each of the gates when required to fill or empty the lock.

The electrical equipment utilized practically all of this machinery as it stood with only the necessary changes to make the mechanical connections with the electrical drive.

In order to keep the speed down to approximately what was obtained by hand operation, a very material reduction in motor speeds was necessary. To obtain this and cover the other points, special apparatus was devised and patented by Mr. Alex. Pringle and myself.

The motors selected were all of a 5 hp. for both the lock gates and weir mechanism. Some question as to whether a 3 or 5 hp. motor should be adopted arose, but the matter was decided in favor of the 5 hp. motor on account of of its lower speed, and while the capacity of this motor is never exceeded except for a few seconds, the balance of the time running considerably under load, yet the whole arrangement is simple and while somewhat stronger than absolutely required, the interchangeability and greater durability we thought justified the slight additional expense.

To operate the two winding winches which control the chains for opening and closing the gates, one motor is located near the hollow coin at the heel of the lock gate—which is coupled by means of a short length of shafting and friction clutch coupling to the winch near this point and by means of another friction clutch and length of shaft sufficient to reach the other winch, supported at intermediate points by pedestals carrying journal boxes mounted on cut stone blocks jointed to the coping, making a practically continuous stone foundation for the mechanism.

As there is a reduction of about 42 to 1, which gives a speed of about 26 revolutions for the operating shaft, we concluded to use the worm gear rather than a more complicated triple reduction by means of spur gears. A sub-base extends under the motor and also carries the casing for the worm and worm gear. The worm runs in oil, the thrust being taken up by alternate steel and bronze collars and thrust disks, adjustable at one end by means of set screws and check nut to compensate for wear.

The motor, which runs at 1,200 r.p.m., is coupled directly to the worm shaft, the worm being cut out of solid steel and meshing into a hobbed bronze wheel turning on a shaft mounted on babbitted bearings; the projection at one end of this shaft having mounted upon it the friction coupling controlling the working shafts. The opposite end being coupled to a short length of shaft which carries a chain wheel similar to a sheave in a chain hoist and from this point by means of a welded link chain made endless, is turned at an angle to the main working shaft, the supplementary shaft for operating the valves in the lock gates. This shaft is supported on bearings secured to the coping of the lock and placed about ½ inch above its surface and continued under the bridge on the lock gate, a universal coupling being utilized at a point near the gate pivot so that the travel of this joint is minimized.

The arc of the circle through which this coupling passes is provided for by a swivel box carrying the end of the driven shaft, and the travel in and out is allowed for by having the chain sheave run free on the shaft except when engaged by a jaw clutch keyed to the shaft so as to allow the shaft to run in and out as it passes through this arc and engage or disengage the clutch at the proper time for controlling the valve mechanism. The clutch being disengaged allowed the driving sheath to run loose on a shaft, the shaft itself remaining idle during the time the gate is open and is only put into operation when the gate is swung to the closed position.

The valves are operated by bevel gear reversing mechanism which allows the operator to either close or open the valves in the gates by throwing the shipping lever which engages a jaw clutch with one of the bevels required to operate the valve stem in the desired direction. The travel of this stem, however, is limited by an automatic stop consisting of a loop and bell crank operated by a pin in the cross head traveling with the valve stem so that at the lower or upper limit of travel, the pin trips the bell crank connecting with the shipping lever so as to throw the clutch out of engagement with the bevel gear which produces the motion.

This mechanism permits of much more rapid lockage than could be carried out by hand and reduces the necessary force of lockmen to one-half the crew formerly required.

LOCKAGES.

While the usual lockage is perhaps a familiar sight, many possibly do not understand it, and a short description will not be out of place.

We will assume that a barge is proceeding up the canal, following another which has previously passed in the same direction. The lock would, of course, be full of water up to the level of the section above. As the barge approaches the lock, the lockmaster starts the motors at the lower end by means of the starting switch on the switchboard in the lock house and two of the lockmen proceed to the lower gate and open the valves, which allow the lock to empty into the lower reach; the mechanism is started on all four valves one after the other. One of the lockmen crosses to the south side and the other to the north side. The mechanism operating the valve stem continues to operate until the valves are wide open and the pin trips the operating mechanism, leaving the valves in this condition until the water within the lock has reached approximately the level of the lower reach. The lockmen on each side of the canal then throw in the friction clutch, which connects by means of a short shaft to the pinion meshing into the large spur wheel on the winch. This winds up the slack on the chain which runs through the chain well over a roller and out to a hook about 4 feet above the sill at the outer end of the lock gate.

As soon as the slack is wound up, the chain commences to move the gate, opening it till it leaves the passage free for the entrance of the barge into the lock. As soon as the boat is moved into position and made fast, the gate is closed by throwing in the opposite clutch which operates the winch at the opposite end of the shaft and closes the gate—the clutch on the first winch being released, of course, allows the chain to pay out as quickly as required to allow the gate to close.

As soon as the gates are closed, the clutch operating the shaft which drives the valve mechanism has moved into engagement and starts the valve driving mechanism, the lockmen throw the lever, starting the two valves in each of the lock gates to close and immediately walk over to the other end of the lock; before they reach it, however, these valves have closed and the tripping mechanism has thrown the clutch out of gear. The valves in the gates in the upper end of the lock are then opened in a similar manner to that described in the emptying of the lock and the water from the upper level flows in and fills the lock to the level of the upper reach. The upper gates are then opened in a similar manner to that described in connection with the opening of

the lower gates, allowing the barge to proceed on its journey.

WEIRS.

To keep the various levels of the canal normal, on account of excessive flow of water from above or any heavy draught of power used on a level or by lockages, the flow of water has to be compensated for by adjusting the weir gates. These gates are operated by worm and segment or in some cases by raising or lowering the valves in a manner similar to that on the lock gates, the operating of which is carried out in much the same way as described in connection with the gates.

As there are a number of weir gates or valves which must be capable of independent operation, provision is made by means of a double jaw clutch engaging with either one or the other of two bevel gears on a horizontal shaft which meshes into a third beveled gear on a shaft of the worm for operating the segment which drives the valve stems. The operator only has to throw the clutch into engagement so as to move the valve in the desired direction, and as soon as the gate has opened or closed sufficiently for the purpose of regulation the lever is thrown out of engagement with the gear.

BRIDGES.

The equipment for the bridges is operated by a motor driving the mechanism through worm gears, the same power unit being utilized as for the operation of the lock gates and weirs, an extension of the interchangeable idea. Aside from the first speed reduction, however, the gearing is quite different, though in the cases of both the Mille Roches and the Stormont bridges the arrangement is worked out on similar lines.

The bridge at Mille Roches is 179 feet x 12 feet and has the motor swung under the bridge just outside the turn table, being couterbalanced by weights at the opposite end of the bridge. A friction clutch communicates the power from the motor-driven worm shaft to one or the other of a pair of bevels, turning the bridge in whichever direction the operator desires. The clutches are operated by two removable levers coming up through the bridge floor so that the bridge tender has already control of both.

To swing the bridge, the operator first starts the motor, then throws the lever which withdraws the bolts, unlocking the bridge; one of the clutch levers is then operated so as to engage the bevel gear required to turn the bridge in the desired direction for opening. The friction slips for a while until it gets the bridge under motion, then it swings rapidly until it is nearly open, when the operator uses the other friction clutch (which tends to turn the bridge in the opposite direction), as a brake to retard the speed, and gradually bringing the bridge to rest in the open position. The reverse motion is used for closing and is operated in very much the same way.

National Electric Light Association Convention.

In addition to the New England Passenger Association and the Trunk Line Association, the Central Passenger Association and the Southeastern Passenger Association have made a rate of a fare and a third for the round trip from all points throughout their territory, for delegates and friends attending the 27th convention of the National Electric Light Association, to be held May 24-27, at Boston. Mr. Frank L. Perry will be in charge of transportation matters for Chicago and vicinity, and will arrange a special train to bring delegates to the convention.

Crocker-Wheeler Company Opens a Branch Office in New Orleans.

The Crocker-Wheeler Company, manufacturers of electric generators and motors, will on May 10 open a branch office in the Hibernia Bank Building in New Orleans. Mr. W. P. Field, of the St. Louis office of the company, will be the representative in charge. Although there are fifteen Crocker-Wheeler branches from Boston to San Francisco, including St. Louis and Atlanta, the establishment of this new office has become necessary in order to accommodate the steadily increasing market for electric machinery in the South and Southwest.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 26, 1904.

Electric Railways and Appliances.

758,230. Train-Control System. Harold E. White, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 20, 1902.

758,355. Trolley-Wheel. James S. Fletcher and Donald H. Waters, Chicago, Ill. Filed Sept. 3, 1903.

758,445. Trolley-Head. Peter D. Hean and John J. Egan, Media, Pa. Filed Dec. 26, 1903.

758,528. Current-Collector. John E. Greenwood, Utica, N. Y. Filed May 16, 1903.

758,592. Safety-Trolley. William M. Gruner and William C. Fink, Springdale, Pa., assignors of one-fourth to Henry G. G. Fink, same place. Filed Nov. 5, 1903.

758,594. Electric Railway-Signal. William S. Jackson Hoboken, N. J., assignor of one-half to David Young, same place. Filed June 30, 1902.

Electrical Machinery and Apparatus

758,057. Ground Connection for Electric Conductors. Frederick P. Fuller, New York, and John J. Walsh, Yonkers, N. Y. Filed Oct. 16, 1902.

758,084. Electric Time-Switch. Henry C. Little, Boston, Mass. Filed Aug. 26, 1903.

758,094. Electric Steam and Vapor Generator. Thos. W. Neely, Marshall, Ill. Filed April 23, 1901.

758,106. Transmission of Electrical Impulses. John S. Richmond, New York City. Filed April 27, 1901.

758,140. Magnetic Brake. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Filed Sept. 2, 1903.

758,157. Means for Preventing Arcing Between Commutator Brushes. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed May 29, 1903.

758,164. Rheostat. William C. Yates, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 16, 1901.

758,172. Blow-out Fuse. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 2, 1902.

758,173. Emergency-Brake. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 14, 1903.

758,174. Air-Brake Controlling-Valve. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 20, 1903.

758,194. Sanding System. William Schaake, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 28, 1903.

758,225. Electric Motor. Alexis Vanderbeck, Roseland, Kan. Filed Oct. 10, 1903.

758,306. Electric Switch. Alan R. Fergusson, New York City, assignor to the Electro-Mechanical Specialty Company, same place. Filed Dec. 16, 1902.

758,324. Support for Electric Conductors. Fred C. Locke, Boston, Mass. Filed Jan. 24, 1903.

758,342. Switch Mechanism for Electric Signs. Frank S. Wahl, Buffalo, N. Y., assignor of one-half to Alfred W. Horn, same place. Filed July 14, 1902.

758,378. Alternating-Current Motor. Ralph McNeill, New York City, assignor to Arthur O. Granger, Philadelphia, Pa. Filed Dec. 4, 1902.

758,478. Electric Switch. Joseph H. Rusby Nutley, N. J. Filed June 25, 1903.

Electric Lights and Appliances

758,328. Device for Securing Incandescent-Lamp Filaments to Leading-in Wires. Albert W. W. Miller, South Orange, N. J., and George. P. McDonnell, St. Louis, Mo., assignors to the American Electric Company, East Orange, N. J. Filed July 3, 1903.

758,589. Light-Controlling System. Harry Faltermayer, Philadelphia, Pa., assignor of one-half to William J. Caskey, same place. Filed Oct. 2, 1903.

Telephones and Telephone Apparatus

758,116. Supervisory Signal Apparatus for Telephone Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company. Filed Sept. 14, 1903.

758,200. Telephone-Climber's Seat. James E. Bennett, Momence, Ill. Filed Dec. 20, 1902.

758,304. Office-Desk Telephone. Alan R. Fergusson, New York City, assignor to the Electro-Mechanical Specialty Company, same place. Filed Nov. 16, 1901.

758,363. Telephone-Receiver. Miller R. Hutchison, Norwood, N. J., assignor, by mesne assignments, to the Hutchison Acoustic Company. Filed Nov. 25, 1902.

758,415. Telephone Instrument. Albert C. Christopher, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Feb. 3, 1904.

758,468. Alternating-Current Signal-Receiving Apparatus. Greenleaf W. Pickard, Amesbury, Mass., assignor to the American Telephone & Telegraph Company. Filed Feb. 29, 1904.

Miscellaneous.

758,202. Telegraph Receiver. Luigi Cerebotani, Munich, Germany, assignor of one-half to Albert Silbermann, Berlin. Filed May 2, 1900.

758,232. Telegraph-Transmitter. Charles Adams-Randall, New York City. Filed Aug. 25, 1902.

758,236. Electromagnet. Harold W. Chamberlain, Brunswick, Me. Filed Aug. 27, 1903.

758,250. Printing Telegraph. Clarence L. Healy, Newark, N. J. Filed June 16, 1903.

758,293. Electromagnetic Gearing. Edward M. Bentley, Lawrence, N. Y. Filed Dec. 2, 1903.

758,303. Electric Heater. Ernst Eckmann, Berlin, Germany, assignor to Martin Petersen, Friedrichsgabekoog, Schleswig-Holstein. Filed Aug. 15, 1902.

758,305. Electric Fan. Alan R. Fergusson, New York City. Filed Dec. 16, 1902.

758,517. Art of Wireless Telegraphy. Lee de Forest, New York City. Filed Sept. 21, 1903.

758,527. Signaling and Operating System. Hedley C. W. Graham, Rochester, N. Y. Filed July 9, 1903.

758,598. Transmission of Electrical Impulses. John S. Richmond, New York City. Original application filed April 27, 1901. Divided and this application filed Sept. 16, 1903.

Reissue.

12,214. Process of Obtaining Tin by Electrolysis. Ernest Quintaine, Argenteuil, France. Filed April 20, 1903. Original No. 699,012, dated April 29, 1902.

THE TELEPHONE WORLD.

Telephone Company in Washington Fixes Own Rates.

A provision in the District of Columbia appropriation bill, fixing the rates for telephone service in Washington, repeals the former act as far as concerns business houses, practically allowing the local company to name its own terms. It does, however, limit to $60 a year the amount to be paid by the Government for an individual metallic circuit line, and to $40, the amount for each telephone when two or more are on the same circuit and the same premises, and fixes like limitations on services for residences.

The previous law on the subject, enacted in 1898, made graded limitations for different services considerably lower than the new rates, but provided no penalty for violations. The local company disregarded the law and nearly 100 injunctions were sued out by subscribers to prevent the removal of telephones after the prescribed rates had been tendered. The cases were bitterly fought, being twice taken to the Supreme Court, which finally decided that the limitations did not apply to metallic circuits.

As the great majority of the business lines were of that character it was a victory for the company, and the subscribers who stood on the law were compelled to compromise their claims. Now Congress repeals that law entirely, raises the limit of cost for telephones in residences to $60 a year and permits the company to fix its own rates for business houses.

To Furnish Supplies for Independent Companies.

The Northern Electric Company has filed articles of association in the office of the Secretary of State at Burlington, Vt., and on May 2 opened headquarters in that city. The company is composed of Burlington and Boston capitalists, and will do a general electrical contract business, paying special attention to furnishing supplies to Independent telephone companies.

The Atlantic City, N. J., line, of the Keystone Telephone Company is expected to be open the middle of this month, making connections with the Atlantic Coast Telephone Company, a subsidiary of the Interstate Telephone Company, which has 1,600 subscribers in Atlantic City, which is about the same number as the Bell Telephone.

The Highland Telephone Company of Elmwood, Wis., formed to establish a telephone system in Pierce and Dunn Counties, is capitalized at $1,000, divided into 50 shares of $20 each. The incorporators are H. A. Miles, W. H. Young, Hugh Bell, Ira J. Smith and William Fensemaier.

A mutual telephone line is being built from Ogden, a station a few miles west of Manhattan, Kan., into the country northwest of that place. The line will be but 3½ miles long, but will connect with long distance lines both east and west. Eventually the promoters of this line expect to extend it farther.

A telephone line is assured for Wapping, Conn. The requisite number of subscribers has been secured. It is expected that the line will be in operation by the 1st of June.

Successful Year for California Independent Company.

The Independent telephone movement in Southern California has been in existence a little over a year. The exchange at Los Angeles now has 9,103 main lines installed and working, 11,732 instruments in use, 400 private branch exchange trunks, 101 private branch exchanges and inter-communicating systems connected directly to central, which have from 10 to 300 lines each. A total of 80-300 pair cables enter this exchange, making one of the largest main distributing racks in the world. The growth has become phenomenal and it has been found necessary to arrange for three branch exchanges to take care of the large number of unfilled orders. A large and increasing business is being done, over 50 toll stations being now connected to Los Angeles. The toll board consists of a two-position desk and another two-position desk is being installed, three more positions are being added to the main exchange, the ultimate of which is 18,000. The longest line entering this exchange and working central energy, is six miles and gives entire satisfaction; the cable portion is probably 4½ miles long.

John Van Lieu is general manager; P. Kerr Higgins, superintendent of equipment, and maintenance, and Fred Hummel, superintendent of construction.

Michigan State Telephone Company.

The statement recently made that a voluntary payment would be made by the Michigan State Telephone Company to the minority stockholders of the Michigan Telephone Company is denied by officials of the former company who state that they have never heard of any such proposition.

News from Chicago states that the charter of the United States Telegraph & Telephone Company has been filed for record with the county recorder. The members of the company are Henry E. Weaver, G. Watson French, Henry L. Turner, Harry D. Critchfield and Harry Rubens. The capital stock of the company is $2,500, and divided into 25 shares at $100 each. Each member holds five shares. The purpose of the company is to construct, own, maintain and operate lines of electric telegraph and telephone in any State, territory or county and to acquire and own everything pertaining thereto.

Bill Brothers, who have just established the new Independent exchange in Lincoln, Neb., are commencing to build an exchange in Sioux City, and are planning to connect the latter city and Lincoln by an Independent long distance line.

The New York & Long Island Telephone Company now has permission to install its system in Babylon, L. I.

The Local Independent Telephone Exchange at Coshocton, O., has concluded to issue $22,000 preferred stock to improve and enlarge its exchange.

The Arrowsmith, Ill., Telephone Exchange has been purchased by Walter Lain.

Sioux City Company Plans for 'Phone Station.

The Sioux City Telephone Company, which is to establish an Independent automatic telephone system in Sioux City, Ia., has fixed September 1 as the date on which the system is to be ready for operation. The plans for this building have practically been completed. It will be of brick and stone and will cost from $20,000 to $25,000. It will be 45 feet wide and 90 feet deep and will have two stories with high floors and a basement, one-half of which will be above the level of the street.

"It is our purpose to locate the building as nearly in the center of the telephone district as possible," said F. G. Bills, secretary and treasurer for the company. "By procuring a site that will be central for our lines as they radiate to the various parts of the city, we will save expense in cable materials, wire and other equipment. Our Lincoln, Neb., system, which we recently finished, was completed in 94 days, and it has about 2,500 subscribers. Here we have thus far about 2,100 names. We have a good deal of material on hand now in the shape of wire, poles, etc., but we want to wait until the poles all arrive before we start our line work."

In Connecticut the telephone companies have established about 6,000 farm stations, and the number is rapidly increasing. At a cost of $18 a year the farmer can place himself in constant and immediate touch with the town and city, receiving market quotations and advices every day, and selling or ordering goods without moving outside of his own home.

Many telephone companies have now entered into partnership with the farmers, and the rural service of a number of the companies is more extensive and valuable than the town service. Better wires are used, superior instruments employed and better general service is maintained all around. The whole country is in a fair way to be gridironed with wires.

The Vanderbilt lines will, within a short time, have a telephone system between New York and Chicago with local exchanges in the different railroad centers between. The line will go through Pittsburg and Youngstown, forming a complete system, independent from the public telephone companies.

A farmers' telephone line to St. Thomas, Minn., is to be constructed by the Cannon Valley Telephone Exchange at Montgomery, Minn.

The farmers in the vicinity of Gresham, Pa., are discussing the question of constructing a co-operative telephone line.

Lines to Manston, Stod and Burau, Minn., are to be built by the Rothsay Telephone Company of that State.

The Rural Telephone Company of Osseo, Minn., will build a telephone line in Hennepin and Wright Counties. Its capital stock is placed at $50,000, but business may be commenced when $1,000 is paid in.

The Otterville-Smithton Telephone Company, of Otterville, Mo., has filed a statement to show that it has made an increase in its capital stock from $2,000 to $5,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alma, Ark.—This town will soon be lighted with electricity.

Ballard, Wash.—H. A. Starkey was lately awarded a 50-year light and power plant franchise, and an ice and cold storage plant will also be erected.

Blakely, Ga.—The Blakely waterworks and electric light plant was completely destroyed by a recent fire. The loss is estimated about $10,000.

Bradford, O.—The Bradford Electric Light Company has been incorporated with a capital of $10,000 by A. W. McCune, J. T. Arnold, Nate Iddings and others.

Caldwell, Tex.—More than half the necessary bonus has been raised for the electric light and ice plant, which Cypher Brothers, of Austin, propose to install.

Chatsworth, Ill.—The Chatsworth electric light plant, of which L. A. Walter is proprietor, will make extensive improvements to the plant by installing additional machinery.

Coggon, Ia.—There is a movement on foot to organize a stock company for the purpose of establishing and operating an electric light plant here.

Coronado, Cal.—The tent city is to have electricity installed for lighting purposes in time for the coming season.

Elreno, Okla.—The Union Light & Power Company has been incorporated by H. T. Smith, R. S. Trulock, and E. E. Blake, for the purpose of building, maintaining and operating an electric light and power plant in conjunction with hot and cold water and a gas system. Its capital stock is $150,000.

Leonard, Tex.—The Leonard Electric Light & Ice Company has applied for a charter. The following officers have been elected: Y. T. Manning, president; R. L. Regney, vice-president; L. H. Saunders, secretary; W. C. Evans, treasurer.

Malvern, Pa.—It is stated that this borough wants plans and specifications from engineers for a gas or electric plant. An engineer is desired to look over the ground.

Menomonee Falls, Wis.—This town is making a movement to put in an electric lighting plant.

Pineville, Ky.—The Pineville Electric Light & Ice Company, of Bell County, with a capital of $25,000, has been formed.

Redfield, S. D.—The citizens will vote on the question of issuing bonds in the sum of $7,500 for the refunding of electric light bonds, and also for the improvement of the electric light plant.

Ruston, La.—Mr. Sanders is supervising the putting in of an electric light system here.

Searcy, Ark.—An improvement district has been formed here for the purpose of installing an electric light plant.

Sutton, Neb.—This town is to have an electric lighting plant, and it is to be provided entirely by private capital.

Table Grove, Ill.—The voters have approved a proposition for the purchase of an electric lighting plant.

Waterville, Me.—The Fort Halifax Power Company has been organized here for the purpose of carrying on an electric light and power plant in Benton and Winslow, with $250,000 capital stock. Harvey P. Eaton, of this place, is president.

Williamsburg, O.—C. H. Lochard, mayor, states that bonds for an electric light plant have been sold. Plans and specifications have been drawn and bids will be received for the contract.

Winslow Ill.—There is some talk of an electric light plant here.

Yankton, S. D.—A special election may be held here to consider the issuance of bonds for electric light improvements.

STREET RAILWAYS.

Des Moines, Ia.—The Des Moines Interurban Railway Company has practically perfected plans to build an interurban electric line between Perry and this city, which it hopes to complete this year.

East Troy, Wis.—C. D. Towsley has been securing the right of way on the proposed electric railway over the old line of the Milwaukee and Beloit grade.

Fairmont, W. Va.—The Fairmont & Manningtou Electric Railway Company has been organized here with T. W. Fleming as president.

Hamilton, O.—The Toledo, Columbus & Cincinnati Electric Railway is ready to float bonds and begin the construction of its line.

Hazleton, Ia.—D. B. Lyons, of Des Moines, is the promoter of the Oelwein & Hazleton Construction Company, capitalized at $10,000, to build an interurban railway here and at Oelwein.

Jeffersonville, Ind.—Work will soon commence in converting Capt. E. J. Howard's mule road into an electric line.

Kansas, City, Mo.—The Metropolitan Street Railway Company will erect an additional power plant at the corner of 12th and Cleveland streets to cost $20,000.

Lancaster, Pa.—The Lancaster & Ephrata Traction Company will build a line through Lancaster.

Lewes, Del.—The survey of the Lewes & Rehoboth electric railway was lately started.

Lisbon Falls, Me.—The Rev. Frank W. Sandford proposes to build an electric railroad between here and Shiloh.

Philadelphia, Pa.—The Philadelphia & New York Traction Line announces that its through service from Camden to Jersey City will be begun May 10.

Piqua, O.—Henry Newman, of Fletcher, asserts that the Addison, Piqua branch of the Springfield, Troy & Piqua Traction Line, will be built soon.

Richview, Ill.—Work will soon begin on the Southern Illinois electric railway line.

Roanoke, Va.—H. M. Darnall, of this city, is interested in the new electric railway company being organized at Floyd, which will build an electric line costing $1,000,000.

Sandusky, O.—Work will soon commence on the Marion, Sandusky & Tiffin Electric Railway Company's line.

Topeka, Kan.—The Kansas City, Olathe, Lawrence & Topeka Railway Company has been formed to build a trolley line between here and Kansas City, with a capital of $1,000,000. The incorporators are William B. Strang and James King Duffy, of New York; Alexander Monroe and John N. Roberts, of Lawrence, Kan., and Eben Baldwin, of Lake View, Kan.

Waterloo, Ia.—The Waterloo electric line will be extended to Westfield.

West Liberty, Ia.—This city has granted a franchise to the Iowa City and Davenport Electric Line to use certain streets of the city

POWER PLANTS.

Birmingham, Ala.—A power plant will be constructed for the generation and electric transmission of power. George B. Burd, Erie County Bank Building, Buffalo, N. Y., is interested.

Granite Falls, Minn.—A company has been organized and incorporated for the purpose of improving the Minnesota Falls water power. E. H Sorlein, H. H. Sorlein and Claus Lende, of this place, are interested. Electric power will be transmitted.

Hagerstown, Md.—Capitalists interested in the scheme to generate electricity at Dam No. 5 along the Potomac River, are planning to make the enterprise far reaching, and unless their plans miscarry they will be in position within the next year to furnish electric current to all cities and towns within a radius of 25 or 30 miles.

Red Bluff, Cal.—It is reported that the Northern California Power Company will install a plant at the gas works in this city to generate electric current.

Spokane, Wash.—Money is being raised to put in a large electric plant to cost from $100,000 to $150,000, and a 300 stamp mill on the Palmer Mountain tunnel property in Okanogan County this season. D. M. Drumheller and Dr. N. Fred Essig, of this city, are interested.

Watsonville, Cal.—The Big Creek Power Company of Santa Cruz will purchase five acres of land in this city as a site for a plant to furnish the local circuit with electric power. About $100,000 will be spent in improving the service here

BIDS WANTED.

Baltimore, Md.—Sealed proposals marked Proposals for Electric Lighting in Druid Hill Park, and addressed to the Board of Awards, care of H. F. Hooper, City Register, City Hall, will be received until May 11 for installing and maintaining electric lights in said park.

Effingham, Ill.—Sealed bids will be received until May 17 by the city clerk for the lighting of the streets for a period of 5, 10 and 15 years from November 5, 1904. Address J. S. Johnson, city clerk,

Washington, D. C.—The Treasury Department is inviting sealed proposals until May 10 for installing a system of electric light wiring and fixtures in the United States court house building at San Antonio, Tex. Drawings, specifications and blank proposals can be obtained upon application to the custodian of the building or to the Secretary of the Treasury, this city.—Sealed proposals are invited until May 11, for furnishing the office of public buildings and grounds of this city with electric battery supplies during the next fiscal year. Address Col. Thomas W. Symons.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 13⅛@13¼c.; Lake 13⅜@13⅝c.; casting, 13@13⅛c.

Holders of Twin City Rapid Transit common stock believe they will receive a dividend of 6 per cent.

The Cincinnati Gas & Electric Company will increase its dividend rate from 4 to 4½ per cent., beginning July 1.

At the annual meeting Monday of the New England Telephone & Telegraph Company the retiring board of directors was re-elected.

It is reported that for the first 26 days of April Brooklyn Rapid Transit showed a gain in gross earnings of over $60,000, as compared with the same period last year.

The Michigan State Telephone Company, the successor to the Michigan Telephone Company, has declared the first quarterly dividend of 1½ per cent. upon its preferred stock.

Stone & Webster report that a dividend of $5 per share has been declared on the Tampa (Fla.) Electric Company, payable May 16 to stockholders of record at the close of business May 5.

The receivers of the Chicago Union Traction Company have issued certificates of indebtedness amounting to $500,000 to pay interest on the floating debt and to meet other urgent expenses.

It is reported in Wall street that the Kings County (Brooklyn) Electric Light & Power Company will soon increase its capital stock and then be taken over by the Consolidated Gas Company.

At the annual meeting on Monday of the Philadelphia Company of Pittsburg G. E. McCauge, formerly traffic manager of the Carnegie Steel Company, and John C. Riley, a local capitalist, were elected new directors.

It is reported that the Public Service Corporation, which controls the trolley lines and gas companies in New Jersey will soon begin to sell tickets from Jersey City to Philadelphia. As far as Trenton, the route will be over trolley lines and from there, it is said, that the company proposes to run a line of boats.

It is stated that the Michigan State Telephone Company has arranged with the holders of Detroit Telephone Company bonds, of which there are $600,000 outstanding, on the basis of $480 in new bonds, $265.25 in preferred and $428.75 in common stock and $250 in cash, in lieu of the January interest on each $1,000 bond assenting.

The action of Governor Bates of Massachusetts last week in signing the bill permitting the Boston & Northern and Old Colony Street Railway Companies to issue a blanket mortgage upon their property paves the way for the financing of the Massachusetts Electric Companies this year without resorting to a stock issue, which, with the preferred stock selling at 73, or 20 points under the selling price of the last $5,000,000 preferred stock issue, could not now be placed to advantage.

For the payment of the assessment of $2.50 per share on the stock of the Philadelphia Electric Company the books will be closed May 20 at 3 P.M., and reopened June 17 at 10 A.M., for the June payment, and closed November 19 at 12 noon and reopened December 17 at 10 A.M. for the December payment. No transfer will be made of any certificates upon which the payment of any installment which is due and payable has not been made. Stock certificates must be presented when payments are made in order to have the same indorsed properly thereon.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price May 2.
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	142⅜
Metropolitan Street Railway	109¾
Metropolitan Securities	76
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	45½
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	66
Philadelphia Traction	96
Union Traction, $17.50 paid	49⅝
Boston.	
Boston Elevated, full paid	142¼
West End Street, com	92
do. do. do. pref	111½
Chicago.	
City Railway	160
North Chicago	70
Union Traction, com	5¾
do. do. pref	30½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	27
do. do. pref	63
Electric Lead Reduction	⅞
Electric Vehicle, com	6
do. do. pref	9
Westinghouse, com	153
do. pref	194
General Electric	158
Boston.	
Edison Electric Illuminating	238
General Electric	158½
Massachusetts Electric Companies, com	20
do. do. do. pref	73¾
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	150
National Carbon, com	29
do. do. pref	104
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	59
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	126½
Western Telephone Company	..
New England Telephone Company	122½
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88¾
Miscellaneous.	
Chicago Telephone Company	18
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	30
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

A Fortune in Car Fares.

A report made public last week by the New York State Railroad Commission, regarding the number of passengers carried on the railways of Greater New York, is extremely interesting and shows what up-to-date electric traction is capable of doing.

The report shows that for the year ending February 29 car lines in Manhattan alone carried 670,000,000 passengers, exclusive of transfers.

This is more than 100,000,000 more passengers than all the steam railroads of the United States carried in the same period, their record being 568,000,000 passengers. In Greater New York more than one billion passengers were transported.

While there was the enormous gain of more than 37,000,000 passengers on the elevated lines during the year the surface lines had only a trivial increase. This is explained by the fact that the New York City Railway Company in operating the Metropolitan Company's street car lines has reached the limit of its capacity. It can provide no further accommodations.

On the surface lines the total number of passengers for the year was 397,644,829, an increase of only 144,311.

Much more promising was the report of the Interborough Company, operating its elevated lines with its longer trains and new electric system. It carried in all 273,133,242 passengers, an increase over the previous year of 37,318,852.

Transfers in Manhattan amounted to 166,000,000. The Union Railway Company carried in the year 21,273,870 passengers, an increase of 1,998,543 over the year 1902-3, which was 19,275,327. With transfers the total number carried was 21,698,501. In the Bronx, all railroads, the total number carried for the year was 22,147,077, an increase of 1,988,636.

In Manhattan the total car mileage of the Interborough was 60,730,337, an increase of 12,870,859 over the previous year. The car mileage of the Metropolitan system showed a total of 62,412,527, a net increase of 954,666.

In a recapitulation for the Borough of Manhattan a total of 670,778,071 passengers carried in the twelve months is shown, an increase of 37,463,163 over the previous twelve months.

In Brooklyn the Brooklyn Heights Railroad Company, which is operating the Brooklyn Rapid Transit system, carried 285,725,986 passengers, an increase of 25,280,425. Transfers amounted to 55,146,001. Car mileage was 54,394,315.

By the Coney Island and Brooklyn Railroad Company 33,129,812 passengers were carried. The total number carried in Brooklyn on all lines was 320,107,163. In Queens, passengers numbered 16,058,-207. In Richmond, on all the roads, 7,744,255 were transported.

In the Greater City the total of passengers on all the lines was 1,036,834,773, which means that the citizens of the metropolis spent last year $51,841,738.65 for being carried to points within the city limits.

* * *

The Design of the Modern Power Station.

The salient features of an electric generating station for power supply, whose design rendered all other considerations subservient to the commercial success of an undertaking as a whole, were discussed in an exhaustive paper which came before the London Institution of Electrical Engineers on Thursday, April 28. The authors, Messrs. C. H. Merz and William McLellan, are consulting engineers who have been associated with some large English generating systems, and many of their observations were the outcome of practical acquaintance with the

design of these works. They omitted particular reference to electric generation from waste products and by water power for obvious reasons—water power being very limited in its English applications, and waste products and their utilization being of sufficient interest to claim a separate paper in order to assure for it an adequate treatment.

Though it may be true that in the past few years engineers have recognized that cheapness and reliability of supply are the main factors controlling the commercial success of electric light and power plants, it is contended that if a station for power supply were designed on similar lines to many existing stations "commercial failure would almost certainly result." To insure reliability of supply, which must really take precedence over everything else, even over economy of production, the governing general principles which must be kept in view are: Simplicity of design, sub-division of plant and apparatus, labor-saving devices and provision for extensions. The complication which existed formerly when station engineers seemed to regard breakdowns as inevitable, and when they devoted attention to minimizing the effect of mishaps rather than to reducing the amount of apparatus in which a breakdown would occur, now appears to be diminishing. To obviate risks of complete shut-downs, due to the failure of a steam pipe, the boiler-house plant must be sub-divided into a series of groups. Indeed it is imperative in a large power station to sub-divide all parts of the apparatus, from the boiler-house to the switchboard, into a series of units, each complete in itself. This is essential in order to obtain reliability of supply, and yet is in no way inconsistent with economy of production. Endless trouble may follow the crowding together of all kinds of water and steam pipes in one trench; and in the same way endless trouble with switchgear may result from fixing many cables or connections for different purposes, either on one panel, or in one partition, or in one trench, as the case may be. In regard to labor-saving devices, the adoption of such apparatus may either increase or reduce the reliability of supply, and before expending money upon them the pros and cons of a case should be systematically considered.

In respect of future extensions, power stations for wholesale supply, if the eventual capital expenditure per unit sold is to be kept down, "must not be designed for to-day;" there is nothing which increases the station capital account so rapidly, and prevents that gradual decrease of capital expenditure per unit sold which should take place with the growth of a system, as alterations to existing work, and rearrangements in order to meet increased output. In deciding upon general arrangements, or the position of any particular piece of apparatus, or the size of any pipe or trench, it is essential to consider whether such decision is likely to affect, or to be affected by, future extensions.

After elaborating at some length upon the main principles governing power station design, Messrs. Merz and McLellan proceeded to discuss some of their effects on the actual design of a station for the supply of three-phase high tension current at 5,000 volts or over. Steam turbines of any type were regarded as being possessed of great advantages over reciprocating engines, on both counts, reliability and economy, and curves of steam consumption obtained from a 1,500 kw. to 2,000 kw. turbine installed at Wallsend power station between two and three years ago were advanced in support of the latter effect. The set ran 7,500 hours without ever having been opened up, and only on two occasions had the bearings needed any re-setting in order to keep the clearance correct, although they were three times examined and the clearance tested. In fact the only faults of any kind which it was ever necessary to repair were the relining of one of the governor throttle valve chests and the renewal of an oil disk.

The authors admitted that the high thermal efficiency of gas engines has long rendered their use attractive to power station engineers, but they have not so far attained the same perfection as the steam turbine; and they contended, in discussing the general question of the steam turbine, that its use "simplifies the remainder of the power station and generally the system as a whole." One of the arguments made use of was this: "Of course such improvements in gas engines may be made as will result in their superseding steam turbines, but if the advocates of gas engines are correct in stating that the present type of gas engine is being rapidly improved upon, it is the more advisable to install at first a cheap plant in order to diminish the cost of superseding it when gas engines approach finality in development."

It was suggested that a very great saving in the total cost of production could be obtained by paying proper attention to the following points: By correctly apportioning the spare plant for each piece of apparatus making up a complete unit; by correctly apportioning the overload capacity of each piece of apparatus; by designing the plant so that the economical rating of each component is identical, and by relying upon the overload capacity not only for dealing with sudden emergencies (say a shut-down of one of the units that may happen to be running at the time), but also depending upon it for the ordinary peak load of the station, or when other plant is being overhauled.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The regular meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held at Columbus, May 13 and 14.

The Canadian Geological Survey reports the Dominion's output of copper for 1903 as increasing about 11½ per cent.

In Vienna, Austria Hungary, telephone call boxes are provided with napkins, bearing the request, "Wipe if you please." The practice of wiping the mouthpiece of the transmitter is a sanitary precaution.

The observation tower at Coney Island, which is 375 feet high, is to be illuminated by 33,000 electric lights.

It is now stated that the Rowland Printing Telegraph system, which has been on trial for the past year in Italy will be adopted by that Government.

Advices from South Africa state that a movement is on foot to electrify a section of the Central South African Railway between Springs and Krugersdorp, also some $400,000 is to be expended in the construction of an electric lighting system at Port Elizabeth, Cape Colony.

Electricity is to be used as the motive power for the grape crushers in Livermore, Cal.

The Government has a contract with the De Forest Wireless Telegraph Company of New York, for the use of its system along the chain of Great Lakes, and 35 stations will be established at important points. The entire service is expected to be in commission before next fall, the first link, that between Buffalo and Cleveland, already being in working order. One station will probably be at the Soo, another at Marquette, a third at Portage Lake (Keeweenaw Peninsula) and a fourth at Duluth, with the probability of a fifth between Portage Lake and Duluth and still another between Marquette and the eastern end of the lake.

THE LATEST PROGRESS IN WIRELESS TELEGRAPHY.

BY EMILE GUARINI.

Translated for "Electricity" by Jean A. Wetmore, M. S., E. E.

(*Concluded from page 244.*)

It is desirable to choose the type of transmission in accordance with the detector employed, and also bearing in mind the purpose in view. The practicable statements of M. Ferrie on this subject merits a restatement.

If detectors are used which integrate the energy received during a series of discharges by a receiving antenna (thermic and hysteresis detectors, etc.), the oscillatory devices, slightly deadened, will give the best output, because the total amount of energy received is considerably greater.

When, on the contrary, we use detectors which are sensitive to the maxima of instantaneous energy corresponding to maxima of tension, such as coherers, it is much better to employ direct oscillatory apparatus on account of the very brisk

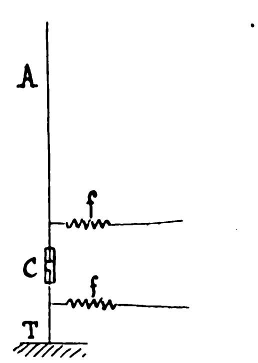


FIG. 19.

variations produced by the shocks of each discharge.

On the other hand, if in the latter case we obtain much greater distance effects, we find that the non-attuned receivers are much more easily operated, and may be annoying in certain instances, nevertheless coherers alone, as we know them up to the present time, allow of the registration of the discharges.

Furthermore, it is found that harmony may be secured, especially with coherers. If it is desirable to obtain it slightly deadened waves must be used. M. Ferrie states that it is necessary to employ antenna in transmission devices, which, taking into consideration the losses, have a lesser effect upon the coherer.

As coherers are almost wholly employed in all wireless telegraph installations, M. Ferrie has classified the various devices, dividing them as follows:

First—Apparatus which is directly acted upon (Fig. 19). The coherer is inserted in the antenna circuit A, which latter may be considered as being insulated by the coherer C and the self-induction f. If the transmitting wave length is attuned to the receiving antenna (the latter being considered as grounded direct) the effect produced by the presence of the coherer will be to double the period of the antenna, since the latter is insulated by it. The action would consequently be very feeble, but in reality the presence of the coherer extends the period of the antenna itself as a result of the capacity of this

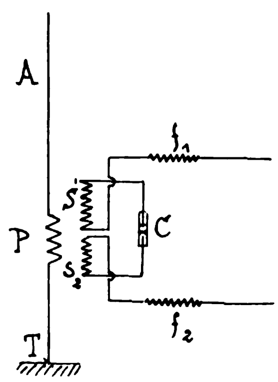


FIG. 20.

instrument. Again the vibratory movement, which is set up in the antenna, effects partially the self-induction f, and the period is thus again lengthened out by this cause. It is to be noted that signals may be received by this process from considerable distances.

Second—Induction apparatus (Fig. 20). This class of apparatus requires a tuning to make it correspond to the transmission wave periods, connecting first with the receiving antenna and then with the circuit which acts upon the coherer. The harmonizing of the receiving antenna is easily accomplished by making it identically the same as that of the transmission, if it is possible to do so, and if it be not possible, the form or the number of wires in the antenna may be modified until the wave lengths become equal to that of the given transmission.

The primary of the transmission ("jigger") is inserted in the antenna circuit, which latter is of short length (about 2 meters) and having a small number of coils, so as not to appreciably change the period of the antenna. It is better to insert these coils in the antenna circuit as near the earth as possible, because the intensity of the oscillations at this point are at their maximum. The secondary is divided into two portions, S^1, S_2, each respectively connected to two self-inductions, f_1 f_2, and to the terminals of the coherer, so we then have to consider two distinct circuits, S^1 f_1 and S_2 f_2.

To harmonize them it is necessary to so establish these circuits that they will have a maximum tension at the extremity of each of them connected to the coherer; but by referring particularly to the works of M. Perrot on the propagation of Hertzian waves in long wires, we must admit that each of these circuits are to be always closely adjusted, whatever the excitation period may be, within certain limits. In fact the stationary waves, which are set up by reflection at the extremity connected to the coherer, are automatically taken up by the self-induction as a result of the deadening of the propagation, whatever their length may be.

We should give to the secondaries, S^1 S_2, a sufficient length at the start from the point where the primary acts (which is always wound upon and wound around both the near extremities of the two half-secondaries) so that it may be able to produce at the extremity connected to the coherer an elevation of tension, in order to secure the Oudin effect. The tensions produced at the coherer terminals of the circuits are of opposite polarities, which results from the direction of the windings.

We are able in practice to easily construct the "mean jigger," that is to say, the transformer, which gives the best results, whatever the transmission wave length may be, from 100 meters up to 1,000 meters, but this is not always the best in every instance. The increase in length, which S^1 S_2 must undergo, so as to obtain the maximum results, are feeble, being of a few turns only.

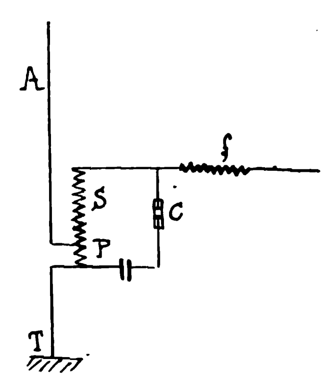


FIG. 21.

It is interesting to note here that the capacity of the coherer is a factor in harmonizing on account of its increased length. Mr. Marconi connects each of the extremities of a condenser to the interior ends of S^1 S_2, but M. Ferrie observes that experience shows that it is of no value.

Third—Derived circuit apparatus. It is necessary to tune up these devices the same as the preceding, i.e., the antenna is made to harmonize with the shunt circuit (Fig. 21), the stationary waves, which are produced in the derived circuit and still drowned in the self-induction f (which is made up of the relay coil in accordance

with the arrangement devised by M. Slaby). But as the coherer must be placed in a tension curve it is important to exactly regulate the length of S, so that this maximum shall be exactly placed at the derived point of the coherer and not any further in the self-induction.

Consequently with this apparatus it is not as easy to construct the "mean jigger," as more accurate adjustments are necessary in each case. This is a good point in this process, but on the other hand the carrying effect must be less, because one terminal of the coherer is at 0 potential, on account of its being connected to the ground, and consequently the single terminal only is at a maximum tension, but the one tension, which it can have, appears to be considerably more than that obtained through induction in the preceding case, for the losses must necessarily be considerably less.

M. Rochefort has attempted to overcome these last mentioned defects by operating in the following manner (Fig. 15): He employs a bipolar resonator (S_1 S_2), and the antenna oscillations determine the production of the two maximum tensions, having opposite polarities at the extremities of S_1 S_2, which are connected to the coherer, but this device requires the use of a coherer of three electrodes, i.e., two coherers in series, for the purpose of preventing a short circuiting of the battery. The advantage resulting from the production of two such tensions must consequently be counterbalanced by a diminution of the coherer's sensitivity.

In this respect we cannot say we agree with M. Ferrie. From the fact itself that M. Rochefort uses a two-chambered filing coherer in series he is thus permitted to place two batteries in tension in circuit with the coherer in such way that the sensitivity of the coherer remains the same. In other words, the advantage which M. Ferrie attributes to the use of the Rochefort devices exists, but not the disadvantage.

M. Ferrie further states that with the Rochefort devices the "mean jigger" cannot be constructed, for it becomes necessary to exactly harmonize S_1 S_2, so as to get a maximum of tension at the extremities. This device consequently appears to give absolutely analogous results to those obtained by M. Slaby, we will add, with the difference that here we have a double tension, i.e., that we can attain a much greater carrying distance with a given amount of energy.

Fourth—Compound devices, derivation and induction combined. M. Ferrie has employed for several years a device in which he has attempted to unite the advantages secured by both the induction and shunt devices (Figs. 22 and 23).

The coherer is operated on by two tension curve waves of opposite polarities, one of which, S_1, is obtained by derivation, and the other, S_2, by induction.

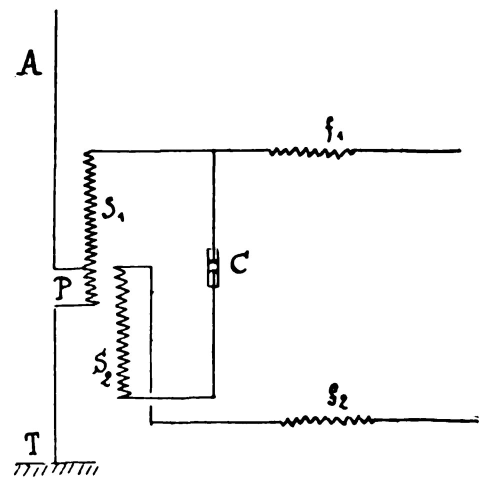


FIG. 22.

The theory stated in the preceding cases still prevails. The two devices (Figs. 22 and 23) are almost equivalents. The one in Fig. 22 may be derived from the induction apparatus (Fig. 20) by joining the interior extremities of S^1 in the latter to the earth terminal.

To sum up, as a result of the preceding discussion, to obtain the maximum operating distance with a station (a ship for example), whose wave length is not known, it is desirable to use a direct excited transmission apparatus, that is to say, a device which is in general public use, as we have shown in the *Scientific American Supplement* of April 25, May 2 and 9,

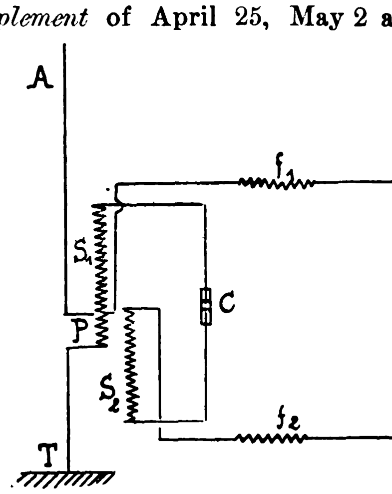


FIG. 23.

1903, and for receiving induction apparatus (Tesla 1897) or a compound device in place of Popoff direct. But for the purpose of communicating with a known station, with the least possible annoyances to the stations which may be in the near vicinity, it is preferable to transmit with an induction apparatus and to receive by means of a derivation or a compound apparatus. The transmission should be more energetic if the receiving is done through derivation, for the sensitiveness of receivers in this class of apparatus is less than with the compound devices, but whatever kind is employed for transmission and for receiving, it is impossible to obtain independence in these transmissions, or in other words, to have simultaneous service in two neighboring stations.

This does not seem to us to be admissible without restrictions, for if, as we have clearly stated, the solution of syntonization can never be absolutely accomplished, the problems regarding secrecy of the dispatches and of the non-interference between stations, it is incontestable that Marconi and Slaby have practically demonstrated that at least, under certain favorable conditions, it is possible to solve these problems and likewise that of multiple transmission.

After the preceding considerations, M. Ferrie took up the matter of the applications made, and he mentioned relative to transatlantic attempts: "The purpose does not appear to have been accomplished." He has cited the American, English, German and Italian installations. Relative to the German, we have just learned that there are already about 250 Slaby-Braun stations, which during the middle of January, 1904, were in operation in various parts of the world, and besides 69 other stations are in process of construction.

M. Ferrie stated that the use of wireless telegraphy in public service in France has shown itself to be very prudent, and outside of its application to the marine, military and war requirements, there has not been made up to the present day, a single installation open to the reception of private telegrams; the installation connecting Martinique with Guadeloupe is very soon to disappear, as the cables have been recently repaired. However the experiment can be considerered as conclusive, and it is probable that new installations will be undertaken at various points. M. Ferrie has been until recently a very great sceptic in respect to wireless telegraphy, which is encouraging for this new kind of communication. He, however, concludes that it will always be of advantage to install a wire between two points which are to be telegraphically connected every time that it is possible to do so, wherever the expenses of doing so are not disproportionate to the prospective income. But we will add, how many countries are there, even in Europe, which can meet such conditions? What must we then say in regard to other continents?

M. Ferrie states that the applications of

wireless telegraphy are consequently not possible on land, except for the requirements of defense or for the colonies.

This appears to us to be saying too little; what, then, is to become of the special applications, such as fire alarms, intercommunication between moving trains, etc.? M. Ferrie's remarks appear to be made from a French standpoint only. Why should wireless telegraphy be of service to the colonies and not in new countries, such as the Congo and South America, etc., where it is difficult, and even impossible, as we have seen in the Congo, to install and above all to keep up wire lines?

On the other hand it may be advantageously employed, as M. Ferrie states, to connect islands with continents, to communicate between boats, and between them and the coasts, with reservations only that the stations are to be sufficiently far from each other, so as not to mutually interfere. Applications of this kind increase from day to day to such an extent that an international understanding has been recognized as being necessary for maritime purposes. The first conference in this respect was mapped out last August in Berlin relative to the preliminaries of a convention for the purpose of submitting technical regulations and to furnish service to all the coast stations which are open to private service.

Although attempts have already been made to build up a monopoly in favor of this or that company, everything leads us to believe that the field will remain an open one for all the systems of every nationality. This appears to us just, although it is true that even though Marconi be the pioneer in wireless telegraphy, it is likewise true that the present devices employed are as a whole the results of work of several inventors.

It is our sincere hope, M. Ferrie states in conclusion, that a new incentive will result from this convention, which will favor the discovery of the necessary improvements in wireless telegraphy, to give to this new means of tele-communication all the safety and convenience in its use which its predecessors have possessed.

M. Ferrie admits that in a future more or less distant wireless telegraphy may be able to attain all the perfection now found in ordinary telegraphy. This is saying considerable, if we recall M. Ferrie's statements on several occasions and even during the course of his present address. In comparing wireless telegraphy with the history of ordinary telegraphy we are practically guaranteed the future success of telegraphy without conductors; we are able to foresee a much larger field for its application and that it will greatly contribute to bring the people of the earth closer together.

ELECTRIC WINDING ENGINES.*

BY MAURICE GEORGI.

Up to the present time in England electrical winding engines are practically unknown, although on the Continent, especially in the mines of Silesia and Westphalia, they have during the last few years made rapid headway. The modern steam winding engine is well adapted to all the demands of the service; it nevertheless absorbs an immense quantity of steam, as the effort is never constant, and therefore the admission in the cylinders is essentially varying. For instance, in starting his machine the driver has to open his stop valve completely, giving full admission in order to shorten the acceleration period. After a certain number of turns of the engine the haul is finished, and he has to stop his machine by using his brakes or giving counter steam to the cylinders; thus the whole of the kinetic energy of the system is lost in the brakes. Should a load be lowered, as is often the case, we possess no means of turning to any practical use the work done by the engine, the liberated energy having to be constantly absorbed by the brakes.

If we now turn to an electric winding engine we find that its first advantage is to diminish very considerably the coal consumption, which can be brought down to about one-third of its original value if a modern generating plant is adopted. Steam turbines, superheated steam, variable expansion, and gas engines fed by producer gas cannot be utilized by the present winding engines, but all are now at our disposal, and as it is now possible to maintain an absolutely constant load on our machinery, an entirely new set of conditions is arrived at in the arrangement of our power-house plant.

Considering that the work done by winding machinery is of the most intermittent character, the torque to be overcome at the beginning being sometimes more than double that during the haul (owing to acceleration), it will be necessary, should no special contrivance be used, to calculate the steam engine driving our dynamos to enable it when starting up to overcome the corresponding torque; and, on the other hand, it must work with an economical admission during the haul and whilst the winding machinery is at rest. These conditions are, as a rule, incompatible, so that engineers have been led to invent means by which energy should be accumulated whilst the winding engine is at rest, this energy being given up whilst working, so to have as far as possible a constant admission in the cylinders, and consequently a high working factor. If we use continuous current our mind is at once led in the direction of a storage battery. This system, so far as theory is concerned, gives a perfect compensation should the battery be properly calculated, but it does not do away with the starting resistance, although the machine can be started in an economical way by a complicated battery sub-division, the motor being grouped on to various combinations of cells.

The disadvantages of such a method of operating are at once apparent; the complicated and delicate electrical contrivances, together with the inherent disadvantages of storage batteries, more than compensate for any gain which may be obtained in efficiency of operation.

On the Continent numerous electric winding engines, and some of considerable importance, have been designed after this system, but have not proved themselves suitable for the operations they had to perform.

There are fortunately, however, other methods, using mechanical means of compensation, which achieve the same purpose by means of massive fly-wheels coupled on our prime movers.

As far as safety is concerned, the conditions that will have to be realized are:

1. The utmost security of working, as winding engines are not only used for the extraction of minerals, but also for transporting men.

2. The speed of the machine will have to be regulated independently of the load —that is to say, independently of the current in the armature, and with the utmost possible economy.

These conditions, especially the second, can be said to have been solved in a satisfactory manner by a new system of compensation discovered by Herr Ilgner, of the Donnersmarckhutte.

The system is based on the well-known fact that a direct current shunt-wound motor with field of constant intensity, and fed by an independent source, will run when an EMF. is applied to the armature terminals with a speed directly proportionate to the voltage, and to the number of turns on the armature. Therefore, if we arrange a continuous-current dynamo with independent excitation, whose voltage can be regulated from zero to a positive or negative maximum by means of a field resistance, a motor

*Abstract of paper presented at a Glasgow meeting of the Institution of Electrical Engineers.

coupled on the same circuit, and having a constant field, will run at a speed varying between zero and a positive or negative maximum.

The starting of the machine is thus most economical, and at any time the power consumed is only equal to the product of the voltage by the current.

To compensate the variations of power required, Mr. Ilgner adopts the following device:

The current taken from the supply drives a converter, composed of a motor, a continuous current dynamo, and a heavy fly-wheel.

An automatic slipping device is fixed to the motor by means of which, should the dynamo call for power, and, therefore, the current in the motor have a tendency to augment, the slip is increased, the fly-wheel giving up kinetic energy. The reverse operation occurs if the dynamo gives no more power, the current in the motor then being used only to bring the speed of the fly-wheel from its present speed to its maximum. The weight and speed of fly-wheel are to be calculated so that for a given slip the output of the motor should remain the same.

Thus the winding engine, as far as the supply station is concerned, may be considered as an ordinary motor of constant output, and treated accordingly.

That the speed is practically independent of the load lies in the fact that we have to do with a shunt motor. This is a most important advantage, possessed by no steam or electrically-driven engine, that to one position of the controller lever corresponds but one speed.

Another advantage is that the machine can be always very economically stopped in the following manner:

Let us suppose that the machine is running at full speed corresponding to the maximum voltage; if we draw the controller lever backwards the voltage of the dynamo will drop, but that of the motor remains the same, so that current will go from motor to dynamo. The system is thus economically stopped, as the recuperated energy is sent from the dynamo through the fly-wheel and motor back into the supply mains. The brakes are absolutely useless excepting for holding up the machine.

If we turn to the actual economy of the system, we find it in no way inferior to that of the very best of other known methods. No starting resistances are used, the energy recuperated at any time is sent back into the line, and the working factor of the fly-wheel is nearly equal to unity.

The current from the dynamo of the converter is carried, without interposition of any switch or fuse, to the winding motor. In this manner no sudden stoppage of the electric supply to the winding motor is likely to occur; the safety appliances are practically useless, as the machine cannot be overloaded, and a short-circuit due to defective cableage is always noticeable immediately. The field magnet exciting current is produced by a small dynamo on the shaft of the converter.

Now, it is of absolute necessity that the voltage of the terminals of this motor should remain the same whatever its speed may be. To produce this, we place a very small dynamo, series wound, next to the exciting dynamo. The current of this auxiliary dynamo passes through windings on the poles of the dynamo, having a demagnetizing effect; thus the fall of speed of converter will have no effect on the voltage, as the loss in turns will be compensated by a stronger field, the current in the auxiliary dynamo diminishing.

The mechanism is so designed that it is absolutely unnecessary for the attendant to pay any attention to slowing down his machine; the apparatus does it for him, and also stops it should he be unable to do so. Moreover, the attendant cannot start too suddenly.

The maximum speed can never be exceeded; a special speed controller is therefore utterly useless.

The sudden stoppage of electric energy from the main does not jeopardize in any way the good working of the engine, as the kinetic energy contained in the fly-wheel is more than sufficient to complete several hauls.

ELECTRICAL STATION PRACTICE.

ARTICLE XXXVI.

BY W. H. RADCLIFFE.

(Concluded.)

The supervision and control of an electrical station is in the hands of the general superintendent or manager. The attributes that must necessarily be possessed by the modern superintendent to render him competent to fill this position successfully, constitute an important feature of electrical station practice, and the presentation of them will conclude this series of articles.

In general, the key to success is an intimate knowledge of the local conditions and requirements. No two stations or plants are precisely alike, and it is the man who knows his station as a small boy his pockets and who keeps constantly in touch with the community, that can make a success of the enterprise. In addition to this the superintendent must be endowed with the necessary amount of practical experience and of technical knowledge, he must also possess executive ability, strict integrity, and good moral character; these fundamental qualifications, together with others, will be discussed in detail later in this article.

The problem that frequently confronts the new superintendent is this: Given an electrical station equipped with old apparatus and machinery, how best to increase the net earnings of this plant without making any radical changes in the equipment? Thousands of dollars have probably been invested in the installation and to throw this away at the start and spend still more in purchasing an entirely new equipment, is usually both injudicious and impracticable. The new superintendent should therefore make up his mind to content himself temporarily with the conditions as they exist, but he should investigate the situation thoroughly so that when he has a certain amount of money at his disposal he will be able to make the most necessary additions and improvements to the plant. It must be remembered that when such additions and improvements are to be made, they should conform with modern practice and be such as to reduce to the greatest extent the cost of current production. The superintendent should not, however, be prejudiced in favor of any one machine, system, or manufacturer, but should investigate thoroughly the respective merits and defects of each relatively to the case in hand, he must also consider in this connection, the requirements that a future growth of the station would necessitate and base his selections accordingly. Having given the matter due consideration, he will be in a position, when the opportunity presents itself, to lay before the directors a clear statement as to the best kind of machines and apparatus to install, their cost, and the profit that will arise from their installation. If his suggestions be acted upon, and his judgment be such that the additions and improvements when made result in an increase of business, he will soon have more money at his disposal, which in turn should be directed toward still further alterations and extensions of the plant,. Gradually, the transformation of the station will thus be brought about, and when satisfactory conditions are once secured every effort should be made toward the maintenance of them.

The station superintendent must of

necessity be a man of many parts; not only must he be perfectly familiar with the operation of the different types of electrical machines and apparatus and of the steam portion of the plant, but he must also thoroughly understand the various overhead and underground systems of distribution. It is equally necessary that he keep posted as to the various applications of electricity to daily life so that he be in a position to introduce or develop business along these lines, thereby increasing the revenue of the station. To be successful he must also be a good business manager. This point has heretofore been overlooked in the engineering courses of technical schools, and the graduates have in consequence often found themselves at a disadvantage in assuming charge of electrical stations. The fierce competition and the small margin of profits which have become prominent features of electrical station practice during the last few years, necessitate the general adoption of the most improved business methods. The station superintendent therefore requires some commercial training; he should be familiar with bookkeeping and with all the details of estimating costs, taking stock, controlling correspondence, and other affairs of a similar nature. Without this knowledge and the ability for organization and management, he cannot successfully perform his duty as superintendent even though he has had both technical training and practical experience in engineering subjects.

The real value of a superintendent to the company by whom he is employed may be said to depend more upon his executive ability than upon any one of the other attributes with which he may be endowed. It is here presumed that a man of good executive ability is himself an excellent judge of human nature, and that he will therefore be able to select and surround himself with subordinates from whom he will obtain the best results with the least expenditure of his own energy. He will of course appreciate the fact that "the laborer is worthy of his hire," and that to obtain and hold good men it is necessary to show his appreciation of them by paying them what they are worth, and advancing them to higher situations when vacancies occur or new positions are opened. Such recognition of able and conscientious service will bring good returns; if, however, promotions are not feasible, a word of appreciation now and then for services faithfully rendered will not usually fall upon stony ground. If the superintendent has himself risen from the ranks so much the better will be understood the conditions of the workmen, and they in turn will hold him in higher esteem if he possess a practical knowledge of the details of their work; he will also be in a position to estimate more accurately the actual value of each class of labor, and therefore to gauge the wages of the workmen accordingly.

The superintendent should not be averse to coming in personal contact with his subordinates, for it is necessary that he know his men to the extent of being able to rely upon them for the proper performance of their duties. It is also in this way that he can best learn of the characters of his employes, and he may possibly receive from them many valuable suggestions; he must, however, be careful to maintain his dignity at such times lest the prestige of his high office be lost. The instructions given by the superintendent to his subordinates must in every case be worded plainly so that no doubt may exist in the minds of the employes as to the proper execution of them; they should, furthermore, be of such a nature that they may be enforced to the letter. Under no conditions must favoritism be shown, and social or political influence should not be considered in the proper enforcement of the rules and regulations of the station.

Inasmuch as the superintendent represents the company before the public, all complaints arising therefrom are brought to him; it is therefore quite necessary that he be sufficiently versed in law to know the liability of the company in case of accidents, and also the rights of the company together with those of the public, under the charter granted. Equally important is it that he familiarize himself with the laws relating to the employment of labor, with the best forms of contracts and specifications, and with the liability of the company in case of injuries to its employes. Legal troubles are liable to arise at any time in the operation of an electrical station of appreciable size, and it is the superintendent who is familiar with the matters previously mentioned that will then be in a position to best protect the company's interests.

The technical training that must necessarily have formed a part of the station superintendent's education is the foundation upon which he builds with material derived from observation and experience. His training should be that of a mechanical and electrical engineer, but in most technical schools the necessary mechanical subjects are included in the electrical engineering course and this course requires from three to four years of study depending upon the educational standing of the man upon entrance. Although more or less experimental work is done in connection with an electrical engineering course at a technical school, it will generally be found to differ considerably from actual working conditions, and it is therefore advisable to afterward supplement the theoretical training thus received with practical experience in some electric light or power station. The length of time required to become thoroughly proficient to assume the position of station superintendent depends altogether on the ability of the man. As in other sciences, those naturally inclined require less time and achieve a more marked success than those whose abilities lie in other directions. The position is such as to require a person possessed of large mental capacity and of a resourceful nature. Problems of an unusual character frequently arise in the operation of a station, the solutions of which cannot be obtained by the application of any cut and dried rules; it is then that the skill and the resourcefulness of the superintendent becomes of particular value in securing satisfactory results. Not only is this true of the solutions of problems which are clearly presented, but it also applies in many cases to the exact conclusion whereon the problem itself is formulated.

In this age of electricity the rapid progress which is being made yearly—nay, monthly, and one may almost say weekly—along electrical lines renders any book on the subject which previously may have been studied in acquiring technical training, more or less out of date; indeed, the same may be said of many electrical books during their passage through the printing house and bindery. It is therefore necessary for every person who desires to keep thoroughly informed and up-to-date on matters relating to improvements in machines and apparatus, together with the best modern methods in station management, as every station superintendent should be, that he subscribe for and read the electrical magazines. By so doing he will keep informed of the ideas of men prominent in his profession, their ideas in the majority of cases being formed either from close observation or from actual practice.

Following the technical training, or if possible contemporaneous with it, should come the practical experience. Practical experience without technical training is hardly sufficient in this age to equip a man for the position of station superintendent. Admitting that experience is a good teacher as far as it goes, it is nevertheless true that many a company has lost many a shekel through a technically

incompetent superintendent, and not infrequently human lives have been sacrificed at the altar of ignorance. As previously stated, the necessary practical experience can well be acquired in some electric light or power station. A number of our largest and best electrical manufacturing concerns also have regular channels through which one possesses a technical education and being fortunate enough to enter can secure much valuable experience in the design and construction, together with the testing and operation, of the various classes of electrical machines, apparatus and appliances. In acquiring this practical experience, the technical training already received is put to test and is thereby impressed more forcibly upon the mind, tending in consequence to develop a sense of self-reliance and of rapid discernment in cases of emergency. The superintendent will not therefore be so liable to become confused when compelled to attend to several important details at a critical moment, and the confidence thereby established in his ability among the employes will give him a certain prestige among them that will react toward his welfare.

Lest the prestige mentioned in the last paragraph develop into self-conceit and as such interfere with the relations which should properly exist between the superintendent and his subordinates, it will be well to state that egotism on the part of the former party will not only react toward his welfare but on the other hand will seriously impede his progress. In order that willingness and hearty cooperation characterize the efforts of the employes, it is quite necessary that they be treated gentlemanly and yet governed in a calm effectual manner. This often requires considerable patience and perseverance on the part of the manager, but the man who is lacking in these characteristics has not the natural ability of a station superintendent. Better far would it be for him to seek calmer channels and less trying situations in which to direct his efforts, for there are many instances in the supervision and control of an electrical station where patience and perseverance are the only means whereby the superintendent can work out his own salvation.

The best means of judging the actual worth of a superintendent to his company is from a profit-making basis. In order that the net profits from any given installation be a maximum, the corresponding costs of operation and maintenence must be a minimum. Of these costs, the former is naturally the larger, and therefore the most important to keep within reasonable limits. To facilitate this work it is advisable to have the various accounts of the station properly divided and subdivided, and the items in each reduced to a kilowatt-hour basis. Comparisons can then more readily be made with the corresponding costs in the operations of similar stations, and from these it will at once be evident in which direction efforts can most consistently be exerted toward the reduction of operating expenses. Having decided upon the object of attack, the superintendent should at first make himself perfectly familiar with the conditions as they exist and then strive to improve them to the best of his ability. The introduction of modern methods and of labor-saving devices which have been upon the market sufficiently long to have proved their standard worth, will go a great way toward attaining the desired result. To reduce the cost of maintenance it is quite necessary to have frequent inspections made of all the machines, apparatus and appliances in the entire installation, and the results entered in proper form upon report blanks. If it be made customary throughout the plant to have the slightest defect noted on the report blanks upon its first appearance, and the defect attended to at once, much less money will be spent in repairs than if the matter be allowed to progress from bad to worse and not remedied until it becomes absolutely necessary to attend to it.

The superintendent is held directly responsible by his employer for the results which he produces. The degree of success or failure of the company rests entirely upon his shoulders, and he should therefore be given the privilege to put into effect whatever methods he deems advisable. Under no circumstances should his methods be disputed or confidence lost in his ability until positive proof of the same is at hand. In the meanwhile perfect harmony should characterize all dealings between the superintendent and his employers, and they should endow him with power plenipotentiary so that his subordinates will regard him as the one man in authority whose orders are not to be questioned. If complaints occasionally arise or accidents sometimes occur, the superintendent should have the hearty cooperation of his employers in smoothing out matters to the satisfaction of the public who may have had to submit to more or less inconvenience. No matter how well regulated be the station or how systematic its operation, occasional accidents will occur, and complaints from an overexacting public will be entered regardless of the efficiency of the service. It is therefore necessary that due allowance be made for irregularities of this nature when they do occur.

If the efforts of the superintendent fail to produce the desired results after he has been in charge for a reasonable length of time, he should be informed of the fact, in a private conference, by his employers. Information regarding the nature of this meeting should be withheld from the rest of the force, for even if the superintendent is to be discharged he will presumably be given a month's notice, and during that time he should exercise the same authority over his subordinates as he did previous to the conference.

SOME REMARKS UPON CAUSES OF BREAKDOWN IN ELECTRIC MOTOR INSTALLATIONS.*

BY A. H. M.

That accidents will happen and repairs from time to time become necessary to all classes of machinery is beyond dispute, but as far as the direct current motor is concerned, the trouble might frequently be avoided by the exercise of a little extra foresight with regard to the details of the installation. How much depends upon mere details, both with reference to the construction of the motors themselves and also the accessories, will probably be made painfully manifest when the machinery has been running for a short period under working conditions. By the expiration of a few months an employe will certainly have found an opportunity of getting a spanner or other equally undesirable article firmly jammed between the armature and pole piece of the open type motor which has so far given no trouble, and this expensive mishap will bring out the advantages of the protected ventilated type with considerable distinctness.

Then, again, those shunt windings (the writer has seen many such) merely insulated from the pole-piece by a few turns of paper and cotton cloth will suddenly develop an earth to the framework, and as a result the field coils must be entirely removed. This points with no uncertain finger to the necessity of a bobbin of hard fiber or similar suitable material for winding the coils upon. With regard to these bobbins, it is highly important that the end disks and connecting sleeve shall be in one piece, or at any rate shall be so joined that oil or moisture cannot find an entrance, as damage to the coils will often make a start at this point if moisture finds its way in. The last few outside layers of wire should also be satur-

*From the "Electrical Engineer," London.

ated with a highly insulating and waterproof varnish, forming practically a damp-proof skin over the whole. The above remarks with regard to insulation will also apply in some cases to the armature, the writer being conversant with several machines in which the insulation between the armature disks and the winding is quite insufficient to stand the test of time, although a really fabulous voltage may have been employed in testing previous to leaving the maker's works.

Or, again, trouble may arise because for some reason the armature of motor No. 3 refuses to revolve, even when encouraged by the application of a current immensely in excess of the carrying capacity of the windings, and when by steadily reinforcing the conveniently handy fuses the attendant at last succeeds in burning out the armature, the machine will be overhauled and the alarming discovery made that the nut provided to hold the commutator in position has worked loose and jammed back against the framework. An additional thin lock nut or even sunk set screw would have saved all this damage. Many a disaster amongst electric motors has been caused by the accidental dragging out of the shunt lead from its terminal. This is one of the most inexcusable of accidents and is directly attributable to the use of ordinary set-screw terminals. Set screws have a habit of working loose in time, especially when subjected to the constant vibration attendant upon the running of an electric motor. Even when firmly screwed down the grip is of a poor mechanical character, and for this reason the shunt lead should not be less in section than $\frac{7}{20}$ S.W.G., and the end should be thoroughly soldered into a thimble and loop, and the loop fitted over an upright threaded terminal, and held firmly by means of a spring washer and a winged nut. It may be added that a large winged nut and a hard bronze spring washer fitted to an upright threaded brass stud form a most excellent terminal for the main current leads as well as the shunt.

The running parts of motors are often unduly strained, especially where a direct drive by toothed gearing is employed, by allowing too large a starting torque with the starting switch arm on the first contact. This is, of course, due to the fact that the total resistance of the rheostat is too low. Probably, in the majority of cases, the starting current required exceeds the full-load current by about 50 per cent., but that is no legitimate reason why such a rush of current should pass through the armature all at once. A properly designed rheostat should have its resistance so graduated that about half of full-load current will pass with the starting arm on the first contact, full-load current on the second, and then, providing that the motor has not started, the current should rise to about 50 per cent. excess on the third contact. Even when the motor does not start with the first two sections of resistance, cut-out work is being done, as the current passing through the armature is tending to move it, and the next rise of current will start the motor without undue shock or strain.

The original cost of an installation is often unduly increased by the employment of motors of the totally inclosed class, owing to the low efficiency of such machines from overheating. There are, of course, cases in which it is necessary to use the totally inclosed type, but the protected ventilated motor would often be equally as suitable for the work and far more economical. Improper connections between the starting switch and the motor are sometimes responsible for damage, especially if the shunt wiring is not properly connected. The writer has seen several instances in which the shunt lead is taken direct from the double-pole switch to the motor terminals. This is quite wrong, as upon opening the double-pole switch the shunt circuit is suddenly opened, and a great strain thrown upon the insulation. The lead for the shunt terminal of the motor should always be taken from the first contact of the armature starting resistance, and upon breaking circuit the shunt discharge will expend itself in discharging through the main resistance. The type of starting switch selected for use in the installation will exercise an immense influence upon the satisfactory, or otherwise, working of the plant.

Starting switches are generally described in makers' lists as a given horsepower and a given voltage. It would be far better if a further sub-division were made classing the switches for heavy and for light duty. A certain starting switch may satisfactorily start a motor of given horse-power and voltage, but may at the same time be utterly unsuitable for continuous and heavy starting work such as starting apparatus is called upon to perform in large engineering works. When the motor is to be frequently stopped and started, and the starting load uncertain, and likely to reach a large excess current, it is absolutely imperative that the carrying capacity of the resistance shall be ample to meet emergencies, otherwise continual expense and annoyance will follow. For the above heavy duty it is necessary to provide contacts of the renewable segment type, and the contact maker should be of ample area.

One other point, which cannot be too frequently driven home, is the absolute necessity of providing reliable fuses in each motor circuit. They are a perfect safeguard, and, where omitted, a heavy bill for repairs and stoppages will mount up swiftly and surely.

The extent to which electric driving has been adopted during the last five years is ample evidence in establishing its superiority over the older forms, and it would indeed be a pity to hinder its further rapid progress by lack of attention to small matters, which may amount to a great deal in the formation of the user's opinion of his installation at the end of year.

The Telegraphic Transmission of Handwriting and Pictures.

Prof. Cerebotani, of Munich, recently lectured at the Berlin Urania on the interesting telegraphic apparatus designed by himself. After continuously improving his invention for many years past, says the *Electrical Engineer*, London, Cerebotani finally tested the same on the telegraphic lines connecting Munich and Augsburg, Milan and Rome, Milan and Turin, and finally Munich and Berlin, the results being quite satisfactory. It is intended to apply the system to wireless transmission of pictures, etc., which would be particularly easy on account of the exceedingly small current intensities (about two milliamperes) sufficient to actuate the receiving apparatus.

The electromagnetic arrangements consist of four coils, comprising two windings each and crossing one another on a small board. According as the currents put into these coils are more or less strong and of the same or opposite directions, an enormous quantity and variety of currents may be generated in both directions, resulting in corresponding electromagnetic effects. The nearly unlimited number and variety of these current impulses is the most important feature of the apparatus, while the receiver shows a similar arrangement. In the case of the apparatus being used as a type-printing telegraph, the metallic types embedded in a non-conductive substance obviously play the most important part with the transmission.

The Cerebotani apparatus, is likely to assume considerable importance as a facsimile telegraph. In the latter case the sending apparatus contains a pen, carried over the paper by means of a system of co-ordinates, and to which corresponds a similar device in the receiving apparatus, which, however, is susceptible of being

modified or reduced. The system of coordinates is embodied by two bars crossing each other at right angles, and being provided each with a slit where the other is made to slide. By means of this device for guiding the pen the latter may obviously be conveyed to any point of the writing paper, producing at each point the current impulse corresponding to the same, and which will cause the pen placed in the receiving apparatus to record this point at the identical place in the receiver. Some practice, it is true, is required to handle the apparatus. A speed of 100 letters per minute seems to be quite practicable, and the apparatus may be used wherever a Morse apparatus is being employed. It may even be connected to a telephone, and used simultaneusly with the latter. The range of transmission seems to be practically unlimited. In the case, however, of any drawbacks being met with in this connection, relays would have to be resorted to.

ELECTRIC LIGHT CONVENTION.

Plans Nearly Completed for the Meeting to be Held in Boston.

Following is the programme of papers and reports to be presented at the 27th Convention of the National Electric Light Association, to be held in Boston May 24, 25, 26 and 27:

PAPERS.

"The Sale of Electrical Energy"—W. F. White.

"Economy Test of a 5,500 Horse-power, Three-Cylinder, Compound Engine and Generator"—J. D. Andrew and W. F. Wells.

"A One-Hundred-Mile Transmission Line"—Robert Howes.

"The Mechanical Stoker and the Human Operator"—Edwin Yawger.

"The Organization and Equipment of an Arc-Lamp Department"—Samuel G. Rhodes.

"Practical Notes on Steam Turbines"—Francis Hodgkinson.

"Electric Light and Power Plants in Connection with Ice Plants"—C. L. Wakefield.

"Single-Phase Power Motors for Electric Lighting Stations"—W. A. Layman.

"A Three-Wire, 500-Volt Lighting System"—Walter I. Barnes.

"Notes on the Internal-Combustion Engine as Applied to Central Station Service"—E. E. Arnold.

"A Proposed System of Standard Instruments for Operating Companies"—H. P. Davis.

"Remote Control of Electrical Apparatus"—William H. Cole.

In addition to these papers, which are already in print, are three or four others on timely subjects which have not yet gone to press, among them one by Dr. F. A. C. Perrine, on "Types of Large Water Power Installations."

REPORTS.

Report on Progress—T. Commerford Martin.

Report of Committee on District Heating—E. F. McCabe, chairman.

Report on Lost and Unaccounted-For Current—C. W. Humphrey.

Report on Purchased Electric Power in factories—W. H. Atkins, chairman.

Report on Office Methods and Accounting—Frank W. Frueauff.

Report on Advertising—LaRue Vredenburgh.

Report on Sign and Decorative Lighting—Arthur Williams.

Report on Analysis of Flue Gases—Henry L. Doherty, chairman.

Report on Standard Rules for Electrical Construction and Operation—Capt. William Brophy, chairman.

Report of Committee Appointed to Investigate the Steam Turbine—William C. L. Eglin, chairman.

Wrinkle Department—Edited by Chas. H. Williams.

Question Box—Edited by H. T. Hartman.

There are 100 or more "wrinkles" submitted. and the Question Box contains nearly 450 questions, nearly every one of which has been answered.

In addition to the papers above enumerated will be the paper an "Underground Construction," for which Past President Doherty will present a gold medal.

ENTERTAINMENT.

Mr. James L. Ayer is chairman, and will have a staff of 63 assistants.

The following programme will be carried out for the entertainment of the visitors.

On Tuesday afternoon the ladies in attendance will take carriages and drive through the Fenway and possibly to some points of interest about Boston.

On Tuesday evening there will be given at Hotel Vendome a lecture on "Historical and Electrical Boston."

On Wednesday morning the ladies will visit the shopping districts.

On Wednesday afternoon there will be a trip down the harbor, and on return a visit to the L street station of the Boston Edison Company.

Wednesday evening will be spent in Symphony Hall, attending a popular concert. All the space within the rail has been reserved for use of the guests and their friends.

On Thursday there will be provided for the ladies a trip in automobiles to Wayside Inn, Lexington and Concord.

On Friday the entire day will be devoted to personally conducted trips in and about Boston. The business sessions of the association will close on Thursday evening, leaving Friday to be devoted purely to entertainment in the manner above outlined. A general information bureau will be established at Hotel Vendome, in charge of Messrs. Vose and Peasley, and in addition to the usual duties that such a bureau is intended to have, during the week lists made of those desiring to take any particular trips to see any particular points on Friday, so that adequate arrangements may be made for properly personally conducting the visitors to such places as they desire to go.

The foregoing briefly outlines the general plan, more definite details of which will be incorporated in the programme, which will be printed in a short time in advance of the meeting.

Prof. Thurston's Successor.

At Ithaca, N.Y., on Saturday the Board of Trustees of Cornell University elected Prof. Albert W. Smith director of Sibley College of Mechanical Engineering, to succeed the late Robert H. Thurston.

St. Louis World's Fair Exhibits.

The Standard Underground Cable Company in conjunction with the McRoy Clay Works have a joint exhibit in Section 3, immediately adjoining the northwest entrance of the Electricity Building, at the World's Fair.

The exhibit shows a cross-section of an actual conduit, consisting of 72 ducts with a manhole at either end, one manhole being complete with a cover, the other being open. A trench 7 feet deep and 5 feet wide extends the entire length of this conduit, enabling close inspection of the method of laying conduits, including the wrapping, concrete base and top, and the general construction of the manholes, showing hangers, pipes to poles, etc.

At one end in the manhole is shown a capstan rigged up for drawing in cables and connected to a cable which is mounted on a reel at the other manhole; the cable being drawn through the ducts and part of the ducts being split so as to show the method of fastening cables to rope, etc.

From the manholes, cables go to distributing poles, showing the method of distribution to aerial cables for telephone, electric light and street railway work, with various terminals used to protect the ends of the cable in such work.

The McRoy Clay Works show piles of clay as it is dug from the ground and the various processes through which the ma-

terial goes to produce the finished duct.

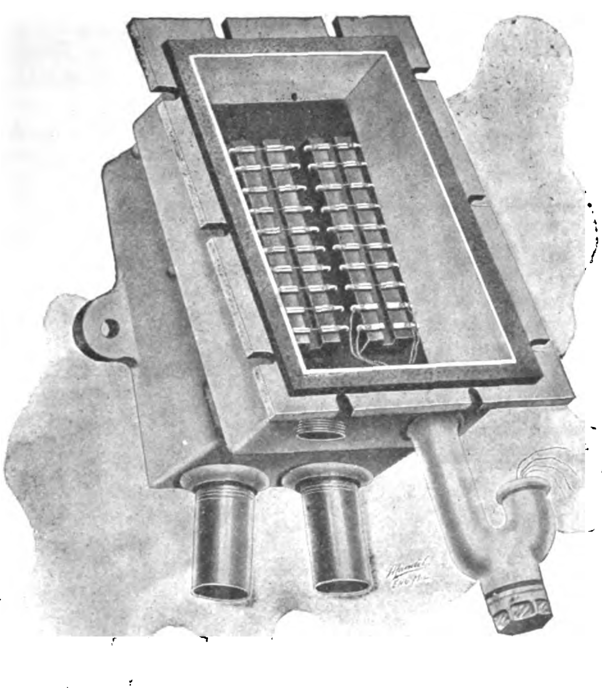
The Standard Underground Cable Company shows samples in handsome cases of all the various cables and appliances made by the company. An examination of this system will show, in every complete detail, the method of installing conduits and drawing cables into completed conduits.

The Andrae O. K. Distribution Box.

Time and practice have demonstrated that the underground electric system, with its clay conduits through which leaded electric cables run, is perfectly safe and economical and a necessity for quick transaction of business by telephone or for public security in connection with fire and police protection.

It is claimed that the Andrae O. K. Distribution Box allows you to add, subtract or change without disturbing the system.

The illustration herewith represents a



ANDRAE PATENTED JUNCTION BOX.

patented junction box. The box is of cast metal and the front side has a removable cover with brass bolts and screw connections, and is provided with a rubber gasket to keep out the moisture. The bottom of the box has two or more tapped openings for screw threaded brass nipples, engaged by the cables, and these brass nipples and cables are united by soldering joints.

Each box is provided with two goose necks which can be attached whenever necessary under the front of the box through insulation to scrape off. No taping and no soldering.

For further information write to Julius Andrea & Sons Co., 225 West Water street, Milwaukee, Wis.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 3, 1904

Electric Railways and Appliances.

758,757. Traction-Engine. William R. Jones, Kremlin, Okla. Filed Jan. 30, 1904.

758,785. Electric-Railway Trolley. David M. Shaler, Stryker, O. Filed Aug. 6, 1903.

758,922. Signaling on Electric-Traction Systems. Thos. H. Jones, Portsmouth, Eng. Filed July 7, 1902.

758,977. Guard-Covering for Third Rails of Electric Railways. John Kress, New Rochelle, N. Y. Filed Dec. 30, 1903.

759,060. Electric-Railway Switch-Point and Operating Means Therefor. Arthur J. Backer, Syracuse, N.Y. Filed July 8, 1903.

759,098. Safety Device for Electric Railways. George Gibbs, New York City. Filed Dec. 24, 1903.

Electric Lights and Appliances

758,644. Electric-Arc Lamp. Thomas Hamilton-Adams, London, Eng. Filed Aug. 29, 1903.

758,730. Electric Lamp. Alexander J. Wurts and Edward Bennett, Pittsburg, Pa., assignors to George Westinghouse, same place. Filed Jan. 10, 1901.

Electrical Machinery and Apparatus

758,610. Controller for Electric Motors. Thomas E. Barnum, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company. Filed Feb. 7, 1902.

758,621. High-Tension Circuit-Breaker. Harry P. Davis, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 13, 1902.

758,631. Collector-Rings and Brush-Holders. Karl F. Elers, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 26, 1903.

758,635. Direct-Current Generator. William H. Foot, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 16, 1903.

758,647-648-649. Electric Safety-Fuse or Cut-out. John A. Heany, York, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. V. Filed Oct. 12, 13 and 14, 1903.

758,667-668. Single-Phase Alternating-Current Power System and Motor. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Dec. 26, 1901, Oct. 31, 1902. Renewed Sept. 24, 1903.

758,669. Brush-Holder for Electrical Machines. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 16, 1903.

758,683. System of Electrical Distribution. John S. Peck, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Aug 8, 1903.

758,702. System of Alternating-Current Distribution. Charles F. Scott, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 13, 1902.

758,726. Indicating or Recording Dynamometer. Edward Weston, Newark, and Adelbert O. Benecke, Vailsburg, N. J. Filed May 31, 1902.

758,756. Electrical Recording Device. James H. Johnson, Louisville, Ky. Filed July 15, 1903.

758,880. Machine for Testing Dynamos. James J. Wood, Fort Wayne, Ind. Filed Aug. 4, 1903.

758,938. Automatic Magnetic Circuit-Breaker. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical & Manufacturing Company. Filed July 31, 1903.

759,004. Alternating-Current Motor. Burton McCollum, Lawrence, Kan. Filed April 4, 1903.

759,096. Frictional Electric Generator. Garabet Germakian, Paterson, N. J. Filed Aug. 22, 1903.

759,119-120. Electrical Conductor and Electric Inductive Conductor. Percy A. McGeorge, West Hoboken, N. J., assignor of one-half to William McGeorge Jr., Philadelphia, Pa. Filed Sept. 10, 1902, March 17, 1904.

759,122. Electric Dynamo. Roger M. Newbold, Birmingham, Ala. Filed Nov. 3, 1903.

759,150. Motor-Starter. William Baxter, Jr., Jersey City, N. J. Filed Feb. 9, 1904.

759,183. Method of Utilizing Single-Phase Alternating-Current Energy. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Original application filed Dec. 26, 1901. Divided and this application filed July 16, 1902.

Telephones and Telephone Apparatus.

758,623. Telephone System. William W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed May 11, 1901. Renewed Sept. 24, 1903.

758,703. Apparatus for Telephone-Lines. Charles E. Scribner and James L. McQuarrie, Chicago, Ill., assignors to the Western Electric Company. Filed Aug. 2, 1900.

758,795. Telephone-Receiver. Ernest H. Strauss, Chicago, Ill. Filed May 25, 1902.

759,094. Telephone-Transmitter. James I. Gemmill, Cleveland, O. Filed Aug. 28, 1901.

759,095. Telephone-Receiver. James I. Gemmill, Cleveland, O. Filed Dec. 22, 1902.

Miscellaneous.

758,638. Lightning-Arrester. Louis R. Gaw, Asbury Park, N. J., assignor to Daniel Killion, Hoboken, N. J. Filed June 3, 1903.

758,650. Electrode for Vapor Electric Apparatus, Peter C. Hewitt, New York City, assignor to the Cooper-Hewitt Electric Company. Filed Jan. 13, 1904.

758,655. Magnetic Ore Separator. William L. Imlay, Philadelphia, Pa., assignor to Adolph Segal, same place. Filed Oct. 2, 1899.

758,692. Storage Battery. William J. Redmond, Cleveland, O. Filed Sept. 29, 1902.

758,701. Electric Burglar and Fire Alarm. Solomon Schwarzschild, Rochester, N. Y. Filed Feb. 24, 1902. Renewed Oct. 8, 1903.

758,724. Signaling System. Joseph Weatherby, Jr., New Cumberland, Pa., assignor to the Weatherby Electric & Manufacing Company, same place. Filed June 1, 1903.

758,73[illegible]. Printing-Telegraph. John C. Barclay, New York City. Filed July 24, 1903.

758,736. Automatic Fire and Burglar Alarm Telegraph. Robert G. Callum, Washington, D. C. Filed March 1, 1902.

758,819. Electric System for Indicating the Temperature of a Distant Point. Robert G. Callum, Washington, D. C. Filed Oct. 28, 1902.

758,842. Wireless Telegraphy. James F. King, Washington, D. C. Filed Dec. 17, 1902.

758,946. Electroheater. Edwin R. Waterman, San Francisco, Cal. Filed July 13, 1903.

759,007. Storage Battery. Job T. Niblett, Greenwich, Eng. Filed Feb. 5, 1903.

759,026. Electric Clock. Herbert Scott, Bradford, and Alfred Loebl, London, Eng. Filed June 10, 1903.

759,041. Magnetic-Speed Indicator. Simon B. Storer, Syracuse, N. Y. Filed April 16, 1903.

759,047. Electric Signal System. George L. Vannais, Hartford, Conn. Filed June 20, 1903.

759,058. Storage Battery. Vincent G. Apple, Dayton, O. Filed June 5, 1901.

759,065. Method of Accumulating and Using Electrical Energy. Anson G. Betts Troy, N. Y. Filed Aug. 17, 1903.

759,066. Electric Storage Battery. Anson G. Betts, Troy, N. Y. Filed Aug. 17, 1903.

759,148. Electric Attachment for Rocking-Chairs. Gaines M. Allen and Samuel M. Cawker, Denver, Col. Filed Nov. 3, 1903.

THE TELEPHONE WORLD.

Southern Bell Expelled from Tennessee.

Last week Chancellor Allison, of Nashville, ordered the Cumberland Telephone & Telegraph Company into the hands of a receiver, and moved that the corporation be ousted from the State. Later he amended his decree, stating that for satisfactory reasons he would decline to appoint the receiver. The telephone company entered an appeal to the next term of the Supreme Court. The appeal vacates the order of expulsion.

The company has an authorized capital of $20,000,000, and about $12,000,000 is outstanding. It controls the telphone situation in the South by reason of its relations to the Bell Telephone Company and has lines radiating into Southern Illinois and Indiana.

The Wolverine Telephone Company has been organized at Coldwater, Mich. The stockholders are all business men of Coldwater. This company and the Southern Michigan Telephone Company will exchange line service. The Southern Michigan Telephone Company is now operating over 500 'phones in Branch County. Coldwater is the largest city in Michigan not having an Independent exchange. That city and Hillsdale are the only two cities in Michigan not having Independent service. Lines are now being built into Hillsdale from all directions, and that city will soon have an Independent exchange.

The Plymouth, Mich., Telephone Company will soon begin the construction of a toll line to Livonia Center, with a pay station at that point, connecting on the way with farm residences. A line is also to be built to Canton. The advantage of these rural lines to Plymouth is very manifest as it brings the farmers in direct touch with the village and helps to build up the Plymouth business.

The Hutchison Wireless Telephone Concession Company of St. Louis, Mo., has been formed to operate a system of wireless telephones on a capital stock of $3.000. Among the men interested are M. R. Hutchinson, New Rochelle; Hallon C. Spaulding, Boston; Edward C. Husted, Joseph A. Wright and L. Z. Harrison, of St. Louis.

The Snyder County Rural Telephone Company was lately organized in Middleburg, Pa., by electing G. Alfred Schock, president, and J. M. Baker, of Beaver Springs, secretary. The company is organized to take the place of the United Telegraph & Telephone Company.

Chester, N. Y., is to have a mutual telephone apparatus of its own. At a recent meeting of citizens the matter was discussed, and resulted in a vote to make application for a charter with a capital of $2,000.

The Lewiston-Auburn, Me., Telephone Company is laying a conduit in which four cables can be placed and 800 persons accommodated on these wires. The automatic telephone system will be used.

The recently organized Independent Telephone Company at Wilkes-Barre, Pa., has C. H. Randall as president.

Bell Company Cannot Enter Van Wert, O

The Central Union Telephone Company tried to secure a foothold in Van Wert to operate an exchange by an application through the probate court, declaring that it had exhausted all means to secure a franchise through council. The city's attorneys filed a demurrer stating that the plaintiff was not entitled to the relief asked because it was a foreign corporation, and Judge Sweet, in a comprehensive opinion, sustained the demurrer. As the Central Union has made application in various probate courts of the State for franchises the decision of Judge Sweet may have a far-reaching effect.

Sanitary Telephone Mouthpieces in Germany.

A special mouthpiece for the public telephones has been introduced in Germany with the object of avoiding the spread of diseases carried by the condensed moisture of the breath. A pad of a large number of disks of paper, with a hole in the middle, is inserted in the mouthpiece, and the upper disk of paper is torn off after every conversation.

Telephones have been installed by the Louisville, Ky., and Southern Indiana Traction Company at all of its stations and sidings between New Albany and Jeffersonville. This will greatly facilitate the movement of the interurban cars and will put the men operating them in touch at all times with the office in New Albany.

The Commercial Union Telephone Company of Troy, N. Y., has filed with the Secretary of State a certificate of an increase of its capital stock from $10,000 to $800,000. The stock is to consist of $300,000 six per cent. preferred and $500,000 common stock. The company also filed a certificate increasing the number of directors from nine to fifteen.

One of the new enterprises of Eldridge, Ia., is the Eldridge Mutual Telephone Company, which was organized in 1903, with an authorized capital of $10,000. It has 150 subscribers, and its lines extend into all the immediate surrounding territory. James H. Wiese is president.

The question of establishing a telephone exchange is causing much interest in Rockport, Mass., and it is expected that some arrangement will be made whereby the telephone will be more generally used there.

The manager of the Home Telephone Company of Ft. Wayne, Ind., states that the company, is installing new telephones at the rate of 100 a month.

At the annual meeting of the stockholders of the International Bell Telephone Company held last week the retiring board of directors was re-elected.

The Independent telephone system at Cape Vincent, N. Y., has been purchased by John H. Grapotte.

An Independent telephone exchange will be installed and operated at Keensburg, Ill, by Elisha Rotrammel.

Telephone Company to Change Name.

The Golden Rod Telephone Company that located in Osceola, Neb., a couple of years ago, reducing the rates a third from what had always been paid for 'phones in that town and county, has sold out to a party from Ida Grove, Ia. The present county treasurer of Ida County, Ia., I. M. Shearer, being the president of the corporation, proposes to change the name to the Polk County Telephone Company..

After considerable agitation on the part of the members of the Business Men's Association, the New York & New Jersey Telephone Company has consented to grant relief from the excessive tariff which has existed previously. Subscribers in Flushing, L. I., have heretofore paid $48 per year, and were entitled to 500 local calls, which include Flushing, Whitestone and College Point. The concession that the company has just made will permit Flushing subscribers to have an unlimited number of local calls for $48 per year. The company has also promised to consider the matter of reducing the toll charges to Jamaica, Brooklyn, Long Island City and Manhattan.

The Olathe, Kan., Citizens' Telephone Company has been sold to Oscar Ayers, of Gardner, Kan, for $20,000. Mr. Ayers is the owner of the Gardner Telephone Company, but will remove to Olathe and manage his new company, of which he is president and general manager. F. R. Ogg has been elected vice-president of the new company; M. G. Miller, treasurer, and H. C. Livermore, one of the directors. The sale included all of the Citizens' Company's lines throughout Johnson County.

The Ravena & Medway Telephone Company was lately incorporated in this State with a capital of $5,000. The line will extend from Ravena to Medway and the town of New Baltimore. The directors are William C. Harden and Ernest Bilz, of Stanton Hill; Harry Thorne, New Baltimore; Clifton Bedell, Aquetuck; E. L. Haight, Arthur Hartt, Frederick C. Bush and Clarence E. Whitney, of Ravena. Harrie McK. Curtis, Coxsackie.

Telephones are being installed in Tewksbury, Mass., and when completed there will be quite a system and one which will prove of much convenience. The only limit on the system is that subscribers in the farmers' system have to pay toll charges when using the line outside of their own town, and the same in regard to persons calling them. Beyond that the service is as available as the general system.

Telephone Incorporations.

The Evansville Telephone Company, Evansville, Ill. Capital stock, $2,500. Incorporators: William Wolff, John V. Tummel and William R. Mathews.

The Tenney Telephone Company, Alma, Wis. Capital stock, $2,000. Incorporators: Jacob S. Tenney, John T. Tenney, Jacob Accola and Valentine Thoeny.

The People's Telephone Company, Mercer, Me. Capital stock. $2,700. Incorporators: C. K. Allen and N. E. True.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alton, Ia.—It is reported that an electric light plant will be erected by the town. The plant will be equipped with modern appliances and machinery.

Alturas, Cal.—The Alturas Electric Light & Power Company has been incorporated by D. E. Mulkey, I. W. Gibnins and others. Its capital stock is $20,000.

Aurora, Ill.—Commencing with June 1 there will be but one electric lighting and power plant here, that of the Fox River Light, Heat & Power Company.

Burlington, Ia.—Messrs. Sweet and Caster will be in charge of the installation of the new electric light plant here.

Clinton, S. C.—The city council is considering a proposition made by some Washington capitalists to put in an electric light and waterworks system.

Depere, Wis.—The Electric Light & Power Company will spend about $1,500 in improving its system.

Elkton, Ky.—The officials have made a five-year contract for lighting the town by electricity with E. L. Peck, who conducts the plant at Guthrie.

Goffstown, N. H.—An electric light plant is being contemplated here. The committee appointed comprises J. G. Dodge, F. A. Parker and others.

Jasper, Ind.—The town board has purchased the electric light plant here of the Jasper Electric Light Company.

Madera, Cal.—The Madera Electric Light Company's plant is to be rebuilt and improved. F. W. Krogh is president. A 150 hp. boiler and a triple expansion engine of 150 hp. will be installed and the line will be extended to parts of the town not heretofore lighted.

Napoleon, O.—Proposals will be received by the village clerk for $25,000 4½ per cent. coupon bonds for electric light improvements.

New Castle, Pa.—Business men here and at New Wilmington and at Pulaski are considering a trolley line to connect the three places. A. B. Getty, J. M. Houston and R. J. Totton are among those interested.

New Concord, O.—J. K. Mercer of Woodsfield, O., has secured the contract for installing an electric light plant for the New Concord Electric Light & Power Company. This company wants one 100 hp. steam engine, and boiler to suit a 75 kw. A. C. dynamo. Dealers having second hand machinery for sale may address the Zogg Electric Company in care of N. A. Geyer, of this place.

New Haven, Ind.—J. M. Jackson, town clerk, states that bids were received for constructing an electric light plant, and all were rejected. Bids may be readvertised about May 15.

Paris, Ill.—George E. Levings and John C. Risser, receivers for the Paris Gas Light & Coke Company, have been unable to dispose of the plant at a private sale, and will publicly auction the gas plant, electric light and heating plant May 21.

Pittsfield, Me.—A recent fire destroyed the large plant of the Pittsfield Electric Light & Power Company, entailing a loss of $50,000.

Salt Lake City, Utah.—The owners of the D. F. Walker Block may install their own electric light, power and heating plant. The estimated cost is about $20,000.

Sayre, Pa.—The council has decided to install five 1,200 cp. electric lights in the business portion of the town, taking the place of gas lights.

Shediac, N. B.—The Shediac Electric Light & Power Company has been granted papers of incorporation by the Legislature.

St. Francis, Wis.—The board of directors of the St. Amelianus Orphan Asylum has voted to install a new electric light plant, including generating outfit and probably some changes in the heating system. George W. Collies, of Milwaukee, is engineer.

Sylacauga, Ala.—At a recent meeting of the council a $20,000, bond issue was authorized, the proceeds of which will be spent in the erection of a water and electric light plant.

Wauwatosa, Wis.—A municipal electric light plant is under consideration. The Advancement Association is interested.

Wichita, Kan.—An electric light and waterworks franchise was lately granted to J. C. Borntregor.

STREET RAILWAYS.

Auburn, Me.—Edgar S. Hill, of Boston, who was recently here on business in connection with the proposed Auburn-Turner Electric Railroad, made satisfactory arrangements with M. J. Googin, of Lewiston, to solicit the preferred stock.

Bainbridge, Ky.—The Chillicothe, Bainbridge & Aberdeen Traction Company is the name of a new company to build a line from Chillicothe via this place to Aberdeen.

Cedarville, O.—The council has granted a franchise to the Springfield & Washington C. H. Traction Company, to build and operate an electric line on the streets of this city.

Chariton, Ia.—Messrs. E. A. Ferrin, of Marshalltown, and F. B. Ufer, of Toledo, are the promoters of the Chariton-Knoxville, Electric Railroad.

Covington, Ind.—James Copeland, C. L. Woody and E. Heath are interested in the proposed electric railroad from here to Rockville.

Danboro, Pa.—A movement is on foot to build an electric railway from Point Pleasant to this place. It is stated that the Philadelphia & Easton will build the road.

Dowagiac, Mich.—H. C. Mason, manager of the McMicheal Electric Railroad interest, says that a franchise is now being secured from Silver Creek Township.

Hillsdale, Ind.—J. H. Roberts, of Grand Rapids, is interested in a new electric line for this city.

Indianapolis, Ind.—The board of county commissioners has granted a franchise to J. P. McGratz, of Hartford City, for an electric road through Delaware Co.—The Chicago & Northern Indiana Railway Company, which proposes to build an electric line from here to Chicago, has filed articles of incorporation in this State.

La Grange, Ind.—The right of way has been secured by the La Grange-Elkhart Electric Railroad Company, of which H. E. Bucklen is president, to build a line between Middlebury and this place.

Leadville, Col.—The announcement was lately made that a first-class electrical system is to be installed in the Yak tunnel. Three miles of underground trolley is one of the features of the proposition. The big electrical plant will be located at the mouth of the Yak tunnel and the trolley wires will penetrate all the crosscuts connected with the property, as well as the main bore.

Mansfield, O.—The Mansfield & Eastern Traction Company will soon commence work on its new traction line.

Marshalltown, Ia.—The promoters of the Marshalltown Street & Interurban Railway Company are planning to run an electric railway through Butler and Grundy Counties.

Mt. Vernon, O.—Fred Jones, of this place, is endeavoring to promote an electric line from Barberton to Doyleston.

Port Huron, Mich.—The City Electric Railway Company has under way plans to improve its lines here.

Schenectady, N. Y.—This city will offer for sale at public auction on May 17 a franchise for the building, construction, and maintenance of an electric railway. J. C. McDonald is clerk of the board of contract and supply.

Taylorville, Ill.—The American Central Traction Company has been organized to build an interurban electric line from here to Shelbyville.

Westfield, N. Y.—A trolley railway that will connect this place with Barcelona, an abandoned port of entry on Lake Erie, a few miles from here, is talked of. Rights of way are being secured. The terminus will probably be used as an excursion point.

POWER PLANTS.

Ceresco, Mich.—It is stated that W. A. Foote, president of the Kalamazoo Valley Electric Company is interested in a $20,000 power plant to be erected here by that company.

Gouverneur, N. Y.—Eli Pettis has sold the old saw mill property to B. G. Parker, of this place, who has purchased the same with a view of developing electric power.

BIDS WANTED.

New Harmony, Ind.—Bids are asked until May 16 for all machinery, apparatus, materials and supplies of every kind for an electric light plant for this city, f. o. b., care New Harmony, or delivered on the ground at site of plant, and for any and all parts of the work. George Cadogan Morgan, engineer, 808 Royal Insurance Building, Chicago; John H. Chaffin, president board of trustees; C. H. Wheatcraft, clerk.

New Haven, Ind.—Bids are asked until May 24 for constructing an electric light plant. Address John M. Jackson, town clerk.

New York City.—The Navy Department, through the bureau of supplies and accounts, is inviting sealed proposals until May 17, for furnishing the New York Navy Yard with 47,000 feet lighting wire, single conductor; two portable testing sets, two ohm-meters, four testing generators, three tachometers, a quantity of platinum, compressed mica plates, etc. Specifications and full information will be furnished intending bidders upon application to the bureau or to the navy pay office in New York.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, $13\frac{1}{8}$@$13\frac{1}{4}$c.; Lake $13\frac{3}{8}$@$13\frac{5}{8}$c.; casting, $12\frac{7}{8}$@$13\frac{1}{8}$c.

The Boston & Worcester Street Railway Company will declare a dividend on its preferred stock in July at the rate of 4 per cent. a year.

A dividend of 2 per cent. has been declared on the Indianapolis Street Railway stock, payable July 1 to stock as registered June 25. The books close on the latter date.

Owing to delay in receiving some of the briefs it is said the decision in the 99-year traction franchise case in Chicago will be delayed about ten days, and the opinion will be given by Judge Grosscup and Jenkins about May 25.

President McCall of the Philadelphia Electric Company says there is no truth in the report that there are any plans being contemplated for the acquisition of the Philadelphia Electric Company by the United Gas Improvement Company.

The Toledo Electric Storage Battery Company, capitalized at $100,000, has been reorganized with Joe Grasser as president. The inventor, George J. Miller, and Messrs. Tyler Greene, Louis Alexander and Mr. Dick remain with the company.

The Mutual Electric Light Company of San Francisco, of which D. O. Mills is a large stockholder, proposes to issue $400,000 five per cent. bonds for extensions. This company is the only competitor of the San Francisco Gas & Electric Light Company.

Judge Colt, in the United States Circuit Court in Boston on Monday, appointed John L. Hall of Boston, John P. Burnett of Southboro, and George E. Newhall of Providence receivers for the Lowell & Boston and the Concord & Boston Street Railway Companies.

The Central Trust Company, as trustee for the bondholders of the Brush Electric Illuminating Company, has brought suit to foreclose the mortgage on the property, alleging that the interest due in January last has not been paid. The bonds outstanding amount to $275,000.

The Peekskill Lighting and Railroad Company has been given permission by the New York State Railroad Commission to increase its capital stock from $500,000 to $650,000, and the Auburn and Syracuse Railroad to increase its capital stock from $1,300,000 to $1,500,000.

The Light, Fuel & Power Company of West Virginia, the stock of which broke from $46\frac{1}{2}$ to $19\frac{1}{2}$ on the sale of 200 shares on the curb in New York Friday morning, and was afterward bid up to 48 by brokers said to represent the company, was formed in 1902 with a capital of $2,500,000.

The report of the Albany (N. Y.) Home Telephone Company, submitted at the annual meeting of the shareholders last week, showed that the company's earnings for the first fifteen months of operation had been 9 per cent. on the stock, after providing for all expenditures for operation and maintenance, and for interest on the 6 per cent bonds.

It is understood that the Metropolitan Street Railway Company of New York is only $125,000 behind last year in its gross receipts to date. It is figured by directors of the Metropolitan Securities Company that the Metropolitan Street Railway at the present time is running within 1 per cent. of its guaranteed 7 per cent. dividend, and this deficit would be quickly made good if the system of collecting fares could be made as efficient on the surface lines as it is on the elevated lines.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price May 9
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	$143\frac{1}{2}$
Metropolitan Street Railway	$108\frac{1}{2}$
Metropolitan Securities	75
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	46
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	65
Philadelphia Traction	96
Union Traction, $17.50 paid	50
Boston.	
Boston Elevated, full paid	$142\frac{1}{4}$
West End Street, com	92
do. do. do. pref	112
Chicago.	
City Railway	160
North Chicago	70
Union Traction, com	$5\frac{1}{2}$
do. do. pref	30
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	27
do. do. pref	63
Electric Lead Reduction	$\frac{7}{8}$
Electric Vehicle, com	6
do. do. pref	$9\frac{1}{2}$
Westinghouse, com	155
do. pref	194
General Electric	158
Boston.	
Edison Electric Illuminating	235
General Electric	$158\frac{3}{4}$
Massachusetts Electric Companies, com	$19\frac{1}{2}$
do. do. do. pref	$72\frac{1}{2}$
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	147
National Carbon, com	29
do. do. pref	102
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	56
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	127
Western Telephone Company	$8\frac{3}{8}$
New England Telephone Company	$122\frac{1}{2}$
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	$1\frac{1}{2}$
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	$89\frac{3}{4}$
Miscellaneous.	
Chicago Telephone Company	18
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	30
Consolidated Car Heating	64
Standard Underground Cable	200

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THE TRADE SUPPLIED BY
THE AMERICAN NEWS COMPANY.

CONTENTS.

EDITORIAL NOTES.

Rapid Transit Talk.

The Rapid Transit Commissioners are considering a proposition of the moving platform syndicate—which has been endeavoring to get permission to do something in this city for so long—to build a subway through 34th street and install in it its moving platform system.

In the application for permission to construct the subway it was pointed out that arrangements had been made for transferring passengers to the elevated and subway lines and that when the Pennsylvania Railroad tunnel and the Post Office, just west of Herald Square, were completed present conditions would be unbearable. This is not to be denied, as the Pennsylvania Railroad Company alone will land passengers at the rate of 600 persons per minute at certain portions of the day.

As a solution of the congestion problem a representative of the moving platform scheme is reported as saying:

"We propose that the subway in 34th street be extended west to 9th avenue and east to 2d avenue, and that it be equipped with the moving platforms or continuous train. In other words, we propose to establish under this important street what may be termed a moving terminal for the continuous collection and distribution of passengers from and to all the intersecting north and south lines.

"For a single fare of five cents we will transport passengers, or cause them to be transported, from any point on the moving platform route to any point in Manhattan or Brooklyn reached by the Interborough Rapid Transit Company, whether by its elevated or subway lines.

"We will also carry over our route without additional fare passengers in transit from any one to any other of the Interborough Company's lines, provided that the journey of such passengers shall be continued in the original direction."

The Borough of Manhattan is of a peculiar shape and is ill adapted to the requirements of a great city, except from the shipping standpoint. There is bound to be more or less congestion of traffic, but it can be minimized by suitable rapid transit subways, equipped possibly with moving platforms, if steps are taken to have them built in time. The underground road should have been built and in operation ten years ago, and it is to be hoped that other subways will be built at once where they are needed and not be begun when they should be finished.

* * *

Electric Motors vs. Shafting.

Considerable has appeared from time to time in technical publications discussing the advantages and disadvantages of electrical driving for engineering establishments. At a recent meeting of the Manchester Association of Engineers in England Mr. B. Longbottom presented a paper bearing on the subject. In it among other things the author stated that in the past there has been great diversity of opinion as to whether each machine in a work should be driven by a motor, or a number of smaller machines should be grouped together and driven from a short line shaft by one motor.

It was, however, now generally recognized that where machines were in constant use, provided they were below a given horse power—say, 5 horse power—grouping was the most desirable. The greatest care, however, must be taken that too many machines were not driven from one motor, or that they were not spread over too wide an area, as that would entail additional shafting. But if a proper system of motor units were employed—and this was the first thing that

ought to be settled in planning the electrical driving of a works—there would be no difficulty in obtaining a high efficiency, as it was only necessary to sub-divide the machines into the most efficient groups to suit the units.

In the average engineering works 5 brake horse power could be taken as the smallest unit to be used, except in special cases of isolated machines, or machines used for intermittent working. This motor had an efficiency of 82 per cent. at three-quarter load, and could, therefore, be looked upon as an efficient power unit.

In the majority of cases the other useful power units could be taken as 7½, 10 and 15 brake horse power, and only in works where very heavy materials were handled would it be found necessary to have larger units, except, of course, for individual machine driving.

It was not only shown that the efficiency of electrical compared favorably with that of mechanical distribution; there were other advantages that could not be overlooked. In these days of specialization it was of the greatest importance that machinery and departments should be arranged with a view to economical and increased output, and it was now possible for the works organizer to achieve that result without taking into account how the power had to be delivered to the machines. It was no longer necessary to arrange the machines in parallel lines down the works so that it could be driven from line shafts supported from the main girders, as was the case with the best arranged mechanical distributions; but under the same roof he could have as many sections of departments as he wished, each entirely self-contained.

It was quite probable that in attaining that result some sections would not be driven as efficiently as might otherwise have been possible; but provided the production was increased by the arrangement with the same outlay in labor it justified itself, and the saving of power, in such an instance, was of secondary consideration. Another advantage was that as they had not to contend with the weight and strain of heavy shafting on the girders, lighter structures could be used, resulting in a material reduction in the cost of the building, thus further defraying the outlay of the electrical plant. Then the advent of portable machine tools and other labor-saving devices had been rendered more possible by the electric motor, and the economies to be obtained by these methods of manufacture were daily becoming more apparent.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Governer Odell vetoed the Niagara Power bill. He declared that the measure was universally disapproved in the State and that he received protests from all over the Union.

Prof. Reginald A. Fessenden has placed a bid with the Russian Imperial Government, on behalf of the National Signaling Company, for the construction of two wireless telegraph stations at Port Arthur and Vladivostock.

The general meeting of the American Institute of Electrical Engineers will be held at the St. Louis Exposition during the week ending September 17, at which no unsolicited Institute papers will be presented or discussed.

About 70 per cent. of the stock of the General Electric Company was unanimously voted last week at the special meeting increasing the capital stock of the company by $3,325,500. After the special meeting the annual meeting was held and directors were re-elected without change.

The number of incandescent lamps to every 1,000 inhabitants is greater in Boston than in any other city in the world.

An English exchange states that a mechanical genius has invented an automatic magnet safety-lock for the doors of railway trains. When the train starts all the "carriage doors" lock automatically and cannot again be opened till the train comes to a standstill, when they unlock automatically. The inventor will not get rich out of royalties in this country.

According to a recent dispatch from Washington, President Roosevelt overruled a decision of Patent Commissioner Allen in a case in which Thomas A. Edison is interested, and directed that a hearing be given to Mr. Edison, which had been denied. It appears that Mr. Edison applied for a patent in connection with his storage battery, and that another inventor working along the same lines, it is alleged, was permitted to withdraw his application and insert it in the substance of Mr. Edison's claims. Mr. Edison protested and asked for a hearing, which the Commissioner refused to grant. President Roosevelt was appealed to and granted the request, but Mr. Allen will have an assistant attend to the matter.

According to an English contemporary a Mr. John Gell, of the New Zealand Postal Department, has invented a new telegraph tape perforator. It appears that the instrument, which is for use in conjunction with Wheatstone senders, is in the form of a typewriter, and that the depression of keys corresponding to the required letters automatically effects the correct perforation and spacing of the tape. It is asserted that the saving in time which may be effected by the use of the new machine will be very considerable, a speed of 72 words per minute having been attained. The instrument may be worked by compressed air or electricity.

President Edgar, of the National Electric Light Association has completed final arrangements for the convention to be held in Boston May 24–27. He says that 25 papers and reports have been printed, and that copies will be distributed to those members who have announced their intention of attending the meeting, reaching them before they leave home, and thus enabling them to prepare themselves to discuss the papers intelligently.

There is renewed talk of a combine among the Independent telephone companies from the Atlantic seaboard to Kansas City. Officials of the Independent companies from Baltimore, Philadelphia and Pittsburg will within the next few weeks inspect systems in the West. Backers of the Pittsburg & Allegheny Company and other Western Independent lines, and President Mack, of the Keystone Company, of Philadelphia, and George R. Webb, president of the Maryland Telephone Company of Baltimore, are now in St. Louis to consider the matter. Former Senator William Flinn, of Philadelphia, is said to be at the head of the consolidation movement.

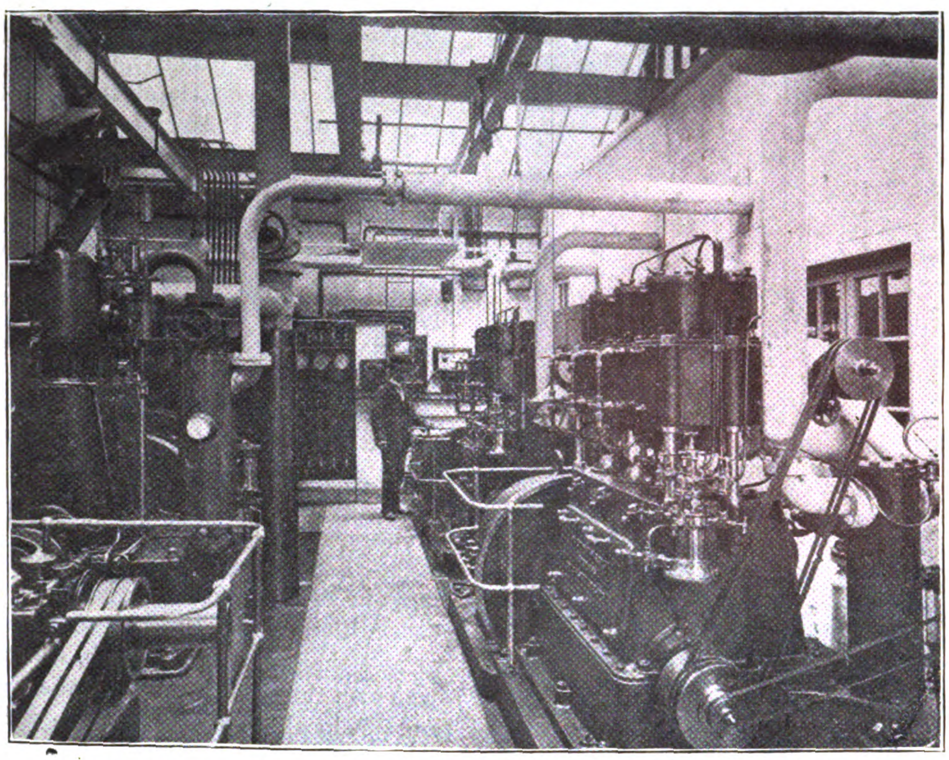
A supplemental report to be issued by the New Jersey State Board of Assessors shows that there are 70 trolley lines in New Jersey, with a total mileage of 980, and the estimated cost of equipment and roads is $160,344,176.31.

A Reuter telegram from St. Petersburg, published in several English newspapers, states that the Japanese, knowing that the Russians have been intercepting wireless messages, tried a clever ruse to deceive and harass the Russians. For several nights in succession, says the *Electrician*, London, they sent messages purporting to come from the Japanese Admiral ordering preparations to be made for landing, for sending fireships into the harbor, for attacking with submarines, and so forth.

A MODERN ENGLISH ELECTRICALLY OPERATED PIANO FACTORY.

BY FRANK C. PERKINS.

One of the largest grand piano-forte factories in the world has recently been completed in England near Old Ford Station and Victoria Park, and it is thoroughly equipped with electric power transmission and lighted throughout by incandescent electric lights. The accompanying illustrations show the power house installation as well as some of the numerous applications of electric power for driving the various cranes, elevators and shop machinery.



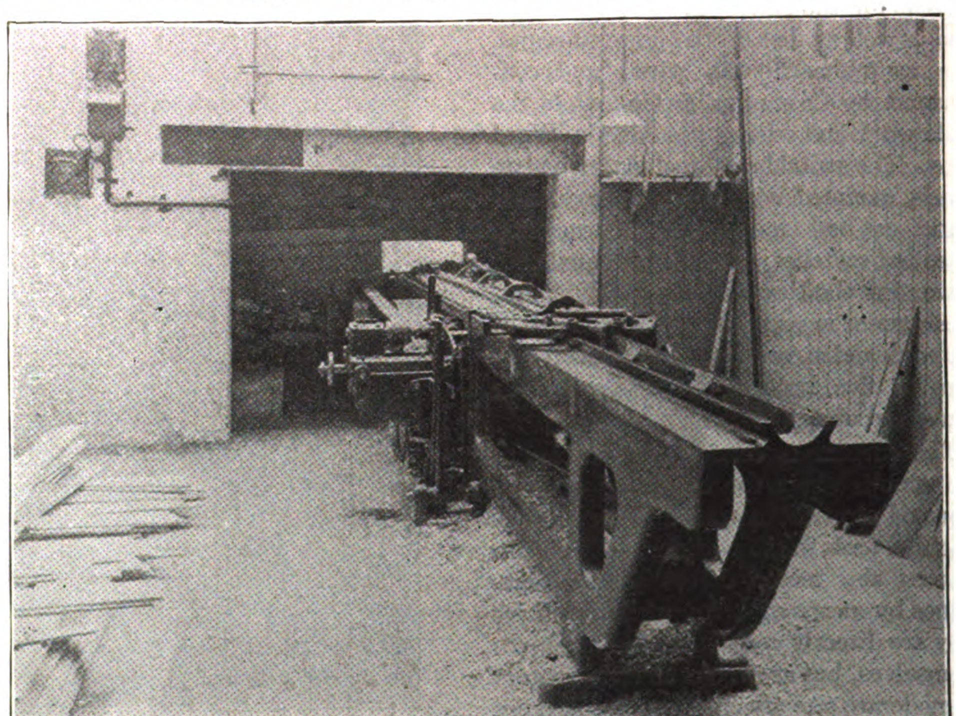
Engine Room in Electrically Operated Piano Factory.

The electric power transmission at the new works of Messrs. John Broadwood & Sons, Ltd., include machines directly driven by individual electric motors, also a combination system of driving the various machines, partly by high speed shafting and partly in groups. An electric railway has also been provided for transporting materials about the works and yards, and three floors are arranged with tramways and overhead traveler rails and appliances for the economical handling of the work, which lead to and from the four $1\frac{1}{2}$ ton elevators operated by 12 hp. electric motors.

An automobile electric crane is used in the yards for handling timber. This traveling jib crane is operated upon the electric railway about the new factory for placing the material in piles on one side of the track or transferring it to the trucks which are used for transporting the same to the ruff mill. This crane has a capacity of two tons, lifting this load at the rate of 50 feet per minute, while the speed when traveling is 220 feet per minute. It has a jib of 14 feet radius and timber may be stacked by it to a height of 12 feet from the ground. It is operated by a 15 hp. motor which runs at a speed of 500 revolutions per minute. It is provided with double friction clutches fitted on the main shaft and is arranged to revolve completely about in either direction. The crane revolves on four rollers and the traveling motion is transmitted by a vertical shaft from the main shaft, the vertical shaft passing through a hole bored in the center pin. The vertical shaft is connected to both of the axles by means of steel beveled gearings under the truck. For lowering a load a foot brake is provided, and while the load is being lifted a brake is arranged to hold it automatically if the current is broken, it being magnetically released when the current is flowing.

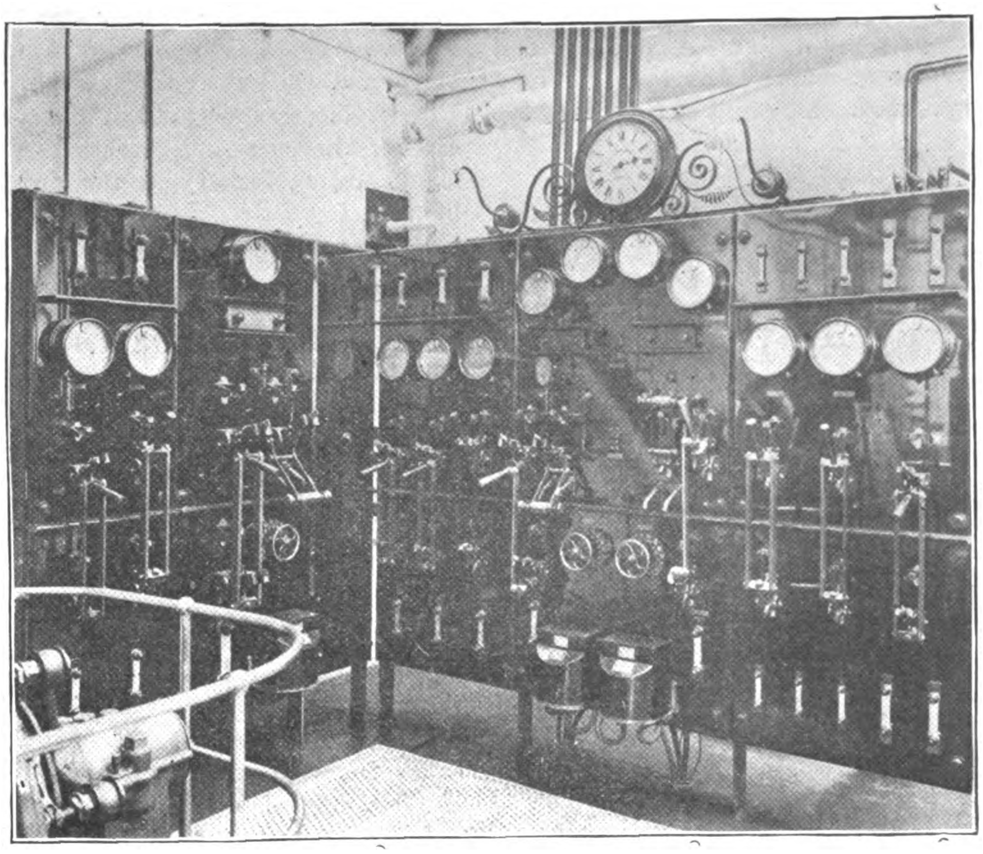
Before mentioning the other electrically operated machines at the works it may be of interest to consider the electrical equipment at the power plant. The boiler plant includes a 100 hp. Babcock & Wilcox boiler, which is fired by waste wood from the shop as well as by the saw-dust and shavings from the wood-working machinery conveyed to it by a Sturdevant pneumatic conveyor equipment. In addition to this boiler there are three locomotive boilers of 320 hp. capacity. The boilers operate at a pressure of 120 pounds per square inch and are supplied with feed water from which impurities have been removed by a Boby-Chevalet detartarizer.

The engine room is equipped with four engines, one of which is employed for driving the shafting of the wood-working shop and metal shop directly by belt transmission, while the other three engines are direct connected to compound direct current dynamos of the Crompton type, supplying current for operating all the other machinery at the works. Two of the engines are of the Peache high speed type, operating at 500 revolutions per minute. These engines are coupled to 40 kw. dynamos which are capable of heavy over-load.



Direct Driven Jointer in Electrically Operated Piano Factory.

The third engine is of the Belliss & Morcom high speed type running at 450 revolutions per minute. It is directly coupled to an 80 kw. electric generator and is capable of taking care of the heavy fluctuations in load successfully, and operates extremely well in parallel with either or both of the 40 kw. outfit. These engines and electrical generators supply the current for the entire incandescent lamp load as well as that of the power circuits. The switchboard was wired and constructed by Crompton & Co., while the cable work and wiring was done by Ward Bros. The switchboard includes five slate panels, mounted with the necessary automatic cut-out measuring instruments, fuses and switches, as well as an equalizing power for the three compound dynamos. The current is generated at a pressure of 230 volts and is conducted by common busbars to five lighting circuits and three power circuits.



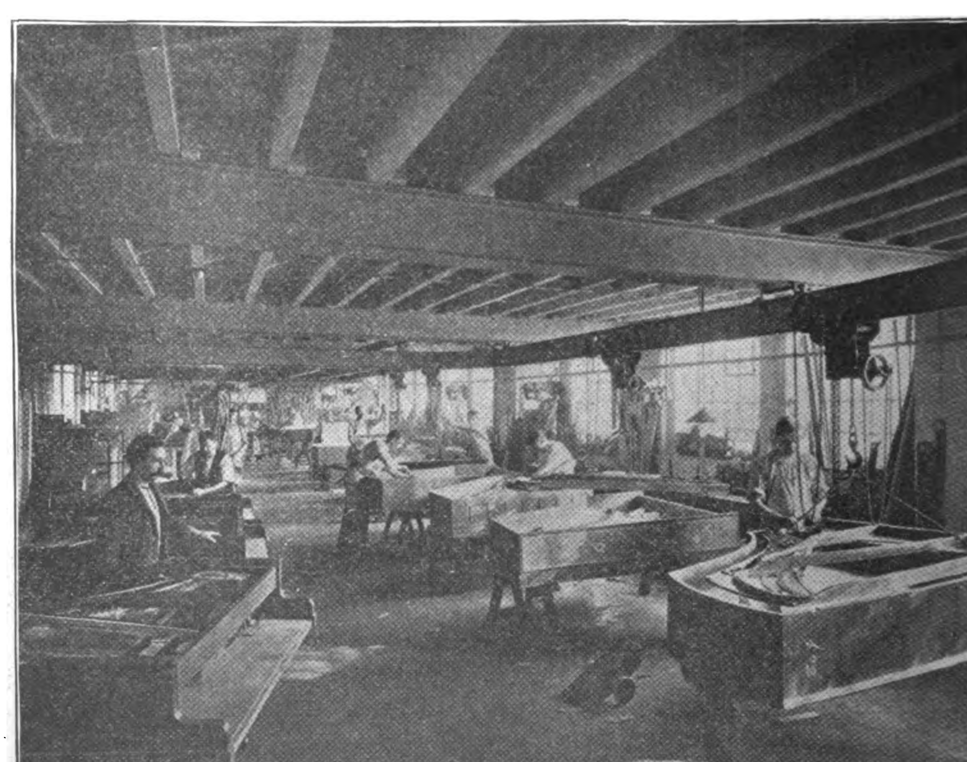
Switchboard in Electrically Operated Piano Factory.

The current is connected by cables to the various shops for operating about a score of electric motors driving various machine tools in the works. In some instances the motor drives separate machines by means of belts, while in others they are directly coupled to the machines themselves, but as a rule electric motors of moderate size are employed for driving groups of machines by light high speed shafting. As an instance of the latter method a 26 hp. motor is mounted on the floor of the rough saw-mill and is used to drive half of the saws in the mill, another 20 hp. motor being utilized for driving the remaining half; the motors are compound wound and thus give a very heavy torque under full load or overload.

To facilitate the removal of the sawdust and shavings every floor is provided with communication with a large shoot, from which the material is carried from the boiler house by a system of pneumatic conveyor, the fans providing the air exhaust and blast at a pressure of 1,000,000 cubic feet per hour, requiring electric motors of 36 hp. capacity; 7 hp. electric motors are mounted on shelves and drive the fans which supply the air exhaust to carry away the saw-dust from the saw benches. As an example of the electrically-driven machine it may be well to mention the new glue-jointing machine, which is directly coupled to an electric motor operating this machine exclusively.

Three of the electric elevators in this plant are of the Pickering type, the remaining two being installed by J. G. Childs & Co. The three-ton electric elevators have two ropes at each corner, which pass around pulleys at the top of the elevator shaft, and the 12 hp. electric motor drives the two shafts by two worm gearings, the thrusts of the latter being balanced.

A system of 20 electric clocks has been installed by the Synchronome Company, insuring uniform time throughout the factory. These clocks are driven by electric impulses sent over the circuits by a single master clock. As each workman enters or leaves the works he moves the arm of the recorder opposite to his number and then presses the knob, which indicates on the sheet the time of the operation. A local telephone exchange with 25 stations has also been provided.



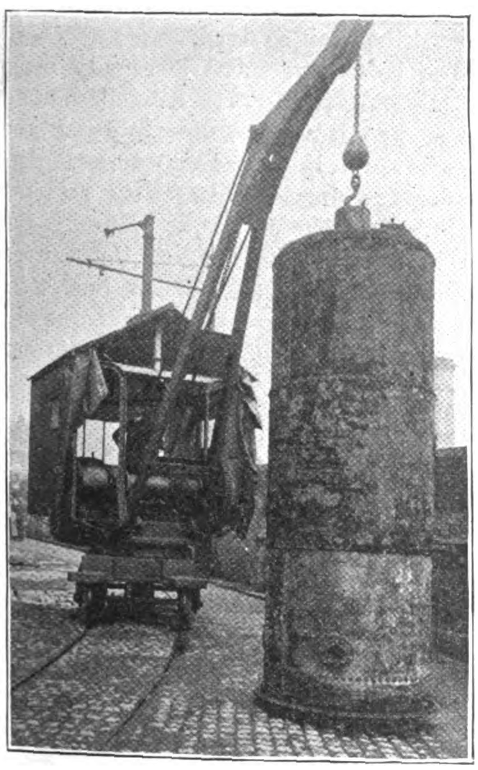
Grand Bellying and Marking Off (Overhead Runway) in Electrically Operated Piano Factory.

It is stated that the advantages of electric power transmission in this factory are most marked, particularly as there are a number of motors operating at considerable distance from the engine room, and

the losses would undoubtedly be excessive were main shafting and belt transmission employed for supplying the necessary power.

A TYPE-PRINTING TELEGRAPH.

A new kind of telegraph printing apparatus, which was introduced in Berlin, Germany, last winter, combines the advantages of the exchange ticker with the telephone service facilities for intercommunication of the subscribers with one another and with the exchange. Dr. Mantler, director of Wolff's telegraph office in Berlin, has taken the matter up, and the apparatus used represents improvements on instruments constructed by Dr. Raps, of Messrs. Siemens & Halske, in 1899, according to the *Engineer and Iron Trades Advertiser*, of Glasgow. Dr. Raps wished to devise apparatus which would enable large firms to communicate their telegraph messages direct to the nearest chief office, and to receive them likewise direct from there without the waste of time which the use of messengers involves. The mechanical power for his printing apparatus was derived from springs, to be wound up at intervals. This is now got from an electric motor. When the spring is wound up sufficiently, two carbon disks are separated from one another, and the motor is thereby cut out. The disks are themselves turned, so that the contact surfaces are kept clean. The instruments are type-printers of simple construction; the printing magnet does not respond to the alternating currents which turn the type-wheel, and the latter is arrested when the current remains steady for a little while. By 1901 the apparatus had so far been improved by Stechern, as we see from the description which Adolf Franke gave before the Elektrotechnische Verein in December, that the telegraph department granted a concession. According to the agreement, the subscribers of the company enjoy the facilities above explained, and the company may further send group messages, as by the telegraph tickers. Since the apparatus must always be ready to receive and print a message, special switches had to be devised for these group messages. These switches interrupt any private communication which happens to pass, and, as long as the group signals continue, a small incandescent lamp glows in every instrument. Messrs. Wolff circulate their political news and the stock quotations in this way. The telegraph department is by privilege empowered to take its wires along the public roads; the company has, however, to come to terms with the authorities as regards this point. Originally, currents of four volts and of eight milliamperes proved sufficiently strong to work the relays, but as the earth potentials amount frequently to several volts, the batteries of accumulator cells had to be strengthened to 12 volts, giving currents of 12 milliamperes. Metallic loop circuits are applied only when indispensable. The new instruments compete, of course, with the telephone, and the central offices are arranged like telephone exchanges.



Electric Crane in Electrically Operated Piano Factory.

MICA AND ITS APPLICATIONS.*

BY J. C. B.

Mica is a substance that is now so very common, that to conjecture as to what would have been the influence on electrical industry had the substance not been a commercial article would be difficult; indeed, as regards electrical progress, mica has always been, as it were, ready at hand to aid any discovery or improvement. On the discovery of the principles of the self-excited dynamo, which marked the advent of both a scientific and commercial evolution, it seems a most fortunate coincidence that such a material should have been to hand, and one that so successfully filled in, so to speak, the interstices of modern progress. Just before this time some practical use to which mica could be applied was being diligently sought after; now, however, what is required are new sources of supply to cope with the multifarious demands for the material. The substance has become now as essential to every branch of electrical engineering as electricity itself seems to be to human progress.

From a geological point, mica, slate and gneiss are the oldest stratified rocks that we are acquainted with. That it was known in past ages is evident from the many marks of ancient operations to be found in mines, and in so many places, for the material was employed for windows, mirrors and ornaments in the early days. In some form or other mica exists all over the earth; it may be found in granite and quartz, rubelite, green tourmaline, feldspar, lepidolite, and many other minerals. It varies in color from white through green, yellowish and brownish shades to black, and its color is greatly influenced by the mineralogical peculiarities of the rock in which it occurs or has been associated, and its commercial value varies also with these circumstances.

One of the most important properties of mica, and one on which its value depends, is the remarkable property of lamination, its structure being so perfect that it is possible to divide it by cleavage into leaves $\frac{1}{250000}$th part of an inch. In consequence of its powerful insulating property, and also the very great advance made in electrical industries, the demand for mica at the present day in almost every country is so great that the supply is almost inadequate. It is not only the superior insulating property of the mineral that gives it such an advantage, but its characteristic and peculiar structure which makes it so adaptable as an insulator requiring very little machining or shaping; for instance, it is a substance which could not be well replaced as an insulator of commutator segments, for it is not only the best but an efficient insulator under every condition. In the case of the commutator its hardness makes it invaluable, for it wears away under the friction of the brushes nearly at the same rate as the hard-drawn copper of the commutator itself.

Further, the fact that heat has no injurious effect on either its physical structure or insulating property, makes it almost indispensable in armature construction, safety appliances, and a multitude of industrial applications, such as lamp chimneys, smoke radiators or preventers, and all purposes where transparency, infusibility, and toughness are required. As is the case with the incandescent burner chimneys, it is also taking the place of gas in many respects,

*From the "Electrical Engineer," London.

especially on board ship, where its combined transparency and tenacity enable it to withstand the wear and tear and the concussion of heavy firing. The qualities of elasticity and toughness are properties in which it is not excelled by anything natural or artificial. These properties are taken advantage of in its employment as an absorbent of nitro-glycerine, and when so used explosions by percussion are rendered less liable, while at the same time nothing is taken from the nitro-glycerine; and for such purposes the pulmose mica is used, or that kind in which the scales are arranged in a feathery form.

The unalterable nature of the substance and its resistance to the corrosive action of acids, smoke and dust, make it also invaluable as a decorative material; the French silver mouldings are made with ground mica, which is accomplished by passing the prismatic or foliated material through a mill, which process increases the bulk forming a mass of translucent and beautiful bean-like scales. Mica is also now being used extensively as a lubricant, and for such purposes it has no superior, except plumbago; it is likewise employed for boiler covering, as roofing material, and as fireproofing for safes, etc. As a reflector of light it has many applications, for it can be readily stamped into any desired shape. At the present time such reflectors are on the market in very many varieties, being admirably adapted to electric incandescent lamps.

Probably the most interesting and beautiful properties of mica are its optical, which, in connection with polarization of light, are both edifying and instructive. Mica under such conditions is what is called a biaxial crystal, which cleaves perpendicular to the bisector of the angle between the optic axis. Its properties in this respect are used for instructive demonstrations of the property of thin films.

There are so many ways of utilizing scrap and cuttings of this material in the manufacture of other insulating substances, such as micanite, etc., that it is almost impossible to find any real mica that may be pronounced useless.

Belgian Commission Decides for Electricity.

A special Dutch Belgian Commission appointed to advise as to the motive power to be adopted for working gates, cranes, swing bridges, etc., at the new Terneuzen docks has, after visiting the principal ports in Germany, England and France, reported in favor of electricity.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE I.

BY W. H. WAKEMAN.

A certain applicant for an engineer's license was asked to determine the bursting pressure of his boiler, to which he replied that it was unknown because it has never burst. This answer has been published in several papers, and has furnished amusement for hundreds of readers including the writer.

However, the answer is very suggestive, and I will venture to say that there are two classes who will partially or wholly indorse the same. One is composed of those who have not given the matter any attention, and the other consists of engineers who have studied the subject a great deal.

In explanation of this apparent inconsistency, I would say that those men in charge of steam plants who have not given the matter due attention are not supposed to know anything about it, nor have any ideas on the same, and nobody will be surprised at this, but the statement that those who have carefully studied the subject, are still in doubt about the answer, requires explanation, and the real object sought in presenting this series of articles is to give this explanation in a way that I hope will be satisfactory to those who read all of the statements made, and then study them.

After an engineer has gained a little knowledge on this important subject, he can answer any question along this line that can be asked, but further consideration and study convinces him that while the answers obtained by given rules and formulas when applied to various boilers, are undoubtedly correct, provided the conditions are fully and correctly stated, yet there are so many things to make allowance for, some of which are difficult to fully understand, that the final answer cannot be stated with confidence in all cases.

It is much easier to determine a pressure under which a given boiler will be safe, and this is a strong point in our favor, because this is a matter that concerns us more than the bursting pressure.

The safe pressure is based upon the bursting pressure, and this would seem to indicate that a knowledge of one assures a perfect understanding of the other, but this is not necessarily true, for the simple reason that the vast difference between them allows so much latitude that we have a good chance to avoid over-pressure.

For illustration of this suppose that the bursting pressure of a boiler is 750 pounds, and 5 is adopted as a factor of safety. This gives 150 pounds as the safe working pressure, and it certainly ought to be safe, for if the former has been correctly determined there is a difference of 600 pounds, therefore if the latter is exceeded by 25 pounds in practice, there is still a margin of 575 pounds.

The uncertainty in the matter is due to the fact that when we apply a given rule to a case in hand, we are not sure that all of the conditions are well known, and as we are certain that some points in the design of our boilers are not fully covered by even our best rules, the only plan that insures a reasonable degree of safety is to allow a wide margin and then not exceed the limit so fixed.

The latter statement is easy to make but not so easy to carry into effect at all times, and it is necessary to break the rule but once in order to do a great deal of damage, provided conditions are just right. Of course it is easy to fix the theoretical safe pressure, set the damper regulator at about 5 pounds less, then place the safety valve weight so that it will lift at the safe limit and prevent further increase of pressure, but this is not all that must be taken into consideration.

Some of the strains due to uneven contraction and expansion, are much greater than direct pressure ever brings upon the several parts, and these are not indicated by the pressure gauge.

Shocks caused by disturbance of the water, although not frequent, are still to be counted among the agents which act for the destruction of boilers, as the writer is well aware of from personal experience.

Uneven distribution of the total load is another cause of trouble that it is very difficult to eliminate. This may be caused by failure of one part, making it necessary for some other to do double duty. When first set, a boiler may rest evenly upon its supports, but later on one or more may settle, thus altering the case, and changing a portion of the load.

When calculating the bursting pressure it is necessary to assume that the parts possess definite strength as a basis, but they do not always have the strength, hence a reduction on this account is warranted.

The tensile strength may be less than the engineer supposed, for in many cases only an estimate can be given. A laminated plate may be the cost of the reduction, for when the several layers of an iron plate become partially separated from each other, the strength is reduced there-

by. If the plate is crystallized, or in other words, where the small parts which compose the plate lose their tenacity largely, it becomes brittle instead of tough, so that although the required thickness remains unchanged the real strength is reduced.

The plate may not be as thick at all points as it is assumed to be, for although modern machinery produces very good results along this line, defects are sometimes found. These may appear as thin spots extending over a comparatively large area, or as affecting only a small surface, yet they are both dangerous.

The riveted joints may not be as strong as calculation asserts, as the rivets may not be as large as regulations call for, and even if full size, imperfect spacing of the holes may cause bad defects in the rivets.

Where old boilers are concerned, corrosion and grooving may have gradually made the plate less efficient.

OPPORTUNITIES IN THE ELECTRICAL FIELD.*

BY GEORGE A. DAMON.

The electrical business is a complicated one and is constantly undergoing changes. By the time a method or system becomes standard enough to be looked upon as a precedent, a tendency develops in some entirely new direction. The men who succeed in electrical work must therefore be quick to grasp the lessons of the past, must be ready to appreciate the limitations of the present, and above all should be alert to seize the opportunities for improvement.

The leaders in the various branches of the industry during the first developments, when electrical work was an art and not a science, were graduates from the well-known university of "Hard Knocks." The men of the second generation of workers who are now doing things are largely the product of a semi-scientific training in schools of technology, supplemented by experience of a practical nature picked up in a more or less haphazard way. A few years more will see the development of a third and better-prepared generation of electrical experts, and it is safe to say that they will be the result of a combination of practical training thoroughly mixed with theoretical education. As it must be expected that the next generation will be superior to the present one, will it not be well to stop for an instant in the strenuous rush for results and make a few suggestions which may be of assistance to our successors in planning their life work?

"Work harder," "dig deeper," "put in a better cement foundation," are the keynotes of the suggestions which our older brothers give us as the result of their experience; and the ambitious young man will be quick to recognize the value of their advice. But what is wanted most is some definite information as to how to spend the time devoted to preparation in the most efficient manner, and how to get the benefit of a combined training in theory and practice in the most effective way.

That those who have traveled well on their way toward their goal have many opportunities to point their way to the ones behind, is well indicated by recounting a recent conversation with a boy of 18.

"I am a senior in the High School," he said, "and I want to become an electrical engineer. What shall I do?"

He was strong, bright, ambitious and willing to work.

"Some men tell me to take a college course first, and enter practical work afterward; some tell me to get a few years' experience first, and then take a college course; while still others tell me to study several years, work a year or two, and then finish my senior year. In planning my course, should I include the language studies, or cut them out in favor of shop, laboratory, or commercial courses? Should I try to get through in three years, or should I extend my college education over a period of five years? Others tell me to leave out the university work entirely, go to work in the shop or upon construction work, getting what theoretical training I require by attendance at night school or by taking a correspondence course. What shall I do?"

And there are some of us who will appreciate the young man's bewilderment.

Knowing that the leading electrical men of Chicago would afford a valuable field for studying results and would welcome an opportunity to help furnish a solution for the problems of the boy, a letter of inquiry was sent to 100 of the leading men in Chicago engaged in the various branches of the electrical industry. An opportunity was given at the same time for the expression of opinion on various questions pertinent to the general subject. The response to the circular letter was hearty and spontaneous; and we are under obligations to 100 of our friends who have so kindly consented to become living examples, and who are willing to be analyzed for the good of the cause. The following is an analysis of results:

Young men control the business. The inquiry was, therefore, confined to men between the ages of 27 and 45, upon the theory that the older men are the product of a set of conditions which have passed away, while the youngest men are, as a rule, still engaged in a period of preparation. The average age is 33½ years.

The average income at each age shows an earning of $2,170 at 27, and this increases to $4,000 at the age of 38. The average income of the entire 100 men is $3,440 per year, which will give us a standard by which we can measure the different branches from a mercenary standpoint.

The 100 men may be divided into groups as follows:

	No. of men.	Average age.	Average income.
Salesmen	7	33	$2,400
Sales managers	11	36	3,400
Business men	10	36	4,800
Sales engineers	8	35	2,350
Electrical engineers	16	33	2,800
Constructing engineers	6	33	2,850
Electrical experts	8	33	3,200
Operating engineers	3	32	2,250
Operating managers and superintendents	10	34	3,550
Professors and editors	8	34	2,500
Patent attorneys	4	32	4,000
Consulting engineers	9	40	6,400

Total number of men, 100. General averages: Age, 33½ years; income, $3,440.

Classified in reference to incomes, the record is as follows:

	No. of men.
Income over $10,000 per year	5
Income between $5,000 and $10,000	9
Income between $2,400 and $5,000	66
Income below $2,400	20
Total	100

It should be stated that there are in Chicago at least 100 more men in the business whose incomes will average about the same as the first 100 selected. An effort was made to make the list representative, and the men were selected on account of their positions without reference to their incomes.

It is to be understood that the dollar is not the most desirable standard by which to measure men individually; but looked upon as a class, a study of the averages furnished by the inquiry is interesting and may be made instructive.

Salesmen who have technical ability or possess engineering information, as a rule, get better salaries than those who do not. Add initiative and executive ability to the salesman's qualifications, and he becomes a sales manager with a still greater re-

*Abstract of paper read before the Western Society of Engineers, Chicago, March 18, 1904.

ward. Enterprise and energy put the man in possession of his own business, or often result in a partnership arrangement. A technical man without the commercial instinct is only fairly well paid. Ability to develop new methods or apparatus puts him in the expert class where the rewards are greater and in proportion to his ability.

Routine work, such as operating, is the least rumunerative work of all. Operating managers and superintendents, however, are very well paid.

The phenomenal development along all electrical lines, and particularly in the telephone business, makes the profession of patent attorney a paying one for those who are qualified for that kind of work.

The field of consulting electrical engineering looks attractive; but it will be noted that the average age is greater in this branch than in the others, which means that the successful consulting engineer brings to his work years of experience, and that it is therefore not a branch to be adopted at once by the young man.

Forty per cent. of the men in the list are employed by what might be termed the "large" companies.

Thirty-five per cent. of the men either control the business in which they are engaged or own a partnership interest.

Twenty per cent. of this 100 successful men never had any college education whatever.

The average age of the 20 men who are succeeding without a college education is 36 years, and their success measured by a monetary standard shows an income of $3,670 per year.

It will be noted that the 20 men without the education are getting along financially slightly better than the general average of $3,440 per year. This is explained by the fact that in their number are included several men who are prospering as a result of their business enterprise.

There are few non-technical men engaged in the strictly technical end of the business who reach the average income. There seem to be more openings for the man without a college training in the telephone field than in any other.

Each of the 100 men included in the inquiry was asked to name the three fields which he considered most promising within the immediate future, and the votes received were as follows:

Electric railway work	63
Telephony	36
Transmission	30
Electro-chemistry	29
Power applications	21
Lighting developments	12
Manufacturing	11
Central station work	9
Patent law	6
Consulting engineering	6
Contracting	5
Management of properties	5
Storage batteries	4
Reconstruction of plants	3
Mining	3
Metallurgy	3
Turbines	2
Wireless telegraphy, designing, high-speed telegraphy, underground-conduit construction, isolated plants, train lighting, and municipal lighting, each	1

Practical experience is as essential as theoretical training. Too little attention has been paid by students in getting into thorough contact with the way things are actually done. This is the result of the general practice of allowing the young man to shift for himself. "I can't get a job without experience," he says, "and I can't get experience without a job;" and then more or less discouraged at the outlook, he takes the first opening which presents itself, and it may or may not be the kind of work for which he is fitted. What is needed is a general clearing-house of information, a closer union between the ambitious student and the successful men who have been pioneers in the work. The electrical business has now progressed so far that the actual experience essential for the highest success along any one of its various lines can be generally indicated by experts familiar with the ground to be covered. It is time, therefore, to abandon a thoughtless and perhaps selfish attitude toward the beginner, and make some organized effort to map out the territory which he must travel with guide posts and signs marked: "This way to the front."

The trouble with a great many young men is that they don't "find" themselves early enough in life. They fail to realize the possibilities, and are not prepared to grasp their opportunities. Ambition, aptitude, preparation, and hard work are the stepping stones to successful attainment. Let the ambition to excel be deeply seated, and directed along the line of natural endowment; let the purpose be firm; and, as day follows night, the preparation will be thorough and the man will be known by his works. "If I had it to do over again I would pick out some definite line of work suited to my talents and work like fury," is the advice of many successful and even unsuccessful men.

The purpose of this paper is to encourage a general discussion, which may be of some help in arousing the latent ambitions of the young men who have not selected their life work, by showing them the boundless opportunities of an undeveloped science; to encourage the efforts of the students in our colleges by presenting the results which have been attained by their predecessors; to crystallize the sentiment in favor of a scientific combination of theory and practice; and, finally, to give an opportunity to the men on the fighting line to point the way to their successors, who must come to the front prepared in every way if they intend to take some part in the phenomenal developments which are to be expected.

In order to direct the discussion along definite channels, the following is offered as a suggestion to a young man seriously considering engaging in the electrical business:

In General.—The purport and intent of this specification is to cover the labor and material required to produce in complete working order a man prepared to attain his own ideal of success in that branch of electrical work he may elect.

It is to be understood that the omission of the mention of small details in this description does not obviate the necessity of their being furnished. What is wanted is a thoroughly trained, well-seasoned, broad-minded man, complete with an individual character, a strong intellect and a sincere purpose.

Plans.—He will form his ambition early in life.

He will take a natural interest in the history of men of eminence in his chosen work, and their achievements will inspire him with a desire to accomplish great things.

He will develop his imagination, and constantly broaden his conception of his own possibilities.

He will seek to learn what the world wants and will then endeavor to train his natural abilities so as to supply that want.

Foundations.—He will as a boy develop a knack of "doing things" either as a mechanic, as a draftsman, or in some boyish business enterprise; and a combination of any two or all three proclivities is desirable.

He must early learn the advantage of doing some one thing well; but he should not allow praise for his proficiency to encourage him to neglect study along the lines he does not naturally fancy.

He will not let the attractions of practical work interfere with his intentions to secure the best theoretical and technical training the country affords.

Capacity.—Even if the young man possesses only ordinary talents, his capacity

for hard, conscientious, intelligent, well-directed work will attract attention and win advancement.

When the occasion demands, he will be able to stand a long run on overload or respond to excessive demands for short periods without permanent injury.

He will be able to direct others, and will not depend entirely upon his unaided efforts for results.

Operation.—He will work quietly, and will be turning in the right direction every minute in a simple, direct and accurate way.

He will join that great army of workers who are actually doing things, rather than that smaller class of men who occupy most of their time telling what they are going to do.

He will make friends among his superiors, who will respect his ambitions and will be glad to assist him in realizing his ideals.

He will study men and know how to deal with them.

Work to Be Done by Others.—Parents should study their children and encourage them to develop their natural tendencies.

More occasions should be made for successful men to meet students and give them the benefit of their advice and experience. The students should not be isolated in a little world of their own, but should be brought in contact with an atmosphere of actual affairs.

Shop Tests.—If he enters the shop or testing department of a manufacturing company, he will make a bargain which will result in his getting an all-around experience in exchange for his services, and while in the shop, will keep "on the move" in every sense of the word.

He will seek to make himself thoroughly practical in all his ideas and methods of work.

Fittings.—He will find it necessary to possess accurate knowledge of nearly every branch of science, including physics, chemistry, mathematics, mechanics, pneumatics, hydraulics, mining, metallurgy, and civil engineering.

He must know something about accounts and a great deal about business and commercial law.

He will find that the electrical business is so broad in its scope that a natural aptitude in any direction can be made of use.

Completion.—He will make every sacrifice to get a thorough preparation and a broad experience up to the age of 28 or 30 years.

He will accomplish much between the age of 30 and 45, at the end of which he will be well settled in his business or profession. Let us leave him at this time to inherit his own. May he live long and prosper!

STEAM TURBINE DEVELOPMENTS.*

The future possibilities of the steam turbine, both for land and marine purposes, represent a question which is attracting a considerable amount of attention in different parts of the world at the present time. Apart from Great Britain, the United States, Germany, Switzerland, and France are now seeking to take a prominent part in the development of the turbine engine, and each country has made a certain degree of progress. A short time ago we referred to the formation of an American-German turbine combination between the various companies represented by the General Electric Company of New York and the Berlin Allgemeine Elektricitats Gesellschaft, which is now entirely absorbing the Union Electricity (Thomson-Houston) Company of the same city. It will be recollected that the object of this combination, which is the first immediate result of the establishment of friendly relations, supported by binding agreements, for the interchange of patents, experience, and inventions between the New York and Berlin companies, is to develop the American Curtis type of turbine, in conjunction with that devised by Professors Riedler and Stumpf in Germany. For this purpose two separate companies have been formed under joint auspices in Germany, one being to promote the patents and the other to construct the engines. At first sight it seemed that the combination aimed at the introduction of keen competition with the Parsons steam turbine, which has not only earned an excellent reputation in certain countries of continental Europe, but has also been adopted to a large extent in central stations; while orders for two marine engines of 6,000 hp. and 10,000 hp. respectively for the German Navy were placed some time ago with the Swiss firm of Brown, Boveri & Co., who are the European licensees for the Parsons turbine.

Recent events, have, however, shown that the desire exists, at all events in interested circles in Berlin, for co-operative action with the licensees of the English company. This is illustrated by the fact that of the increase in the share capital which has just been sanctioned from $15,000,000 to $21,500,000, the Berlin Allgemeine Company is devoting a portion to the acquisition of one-half of the share capital of the Brown-Boveri Company. The arrangement to this effect has been made with shareholders in the latter company, and is not necessarily the subject of an agreement with the directors. The formation of one turbine combination, interesting as it may appear, has actually been followed by the constitution of another, and what is of equal importance is the evidence that the other great German electrical group is concerned in the second syndicate, together with certain leading firms in the mechanical engineering branch in Germany, Switzerland and France. The new combination, which has been established to promote the use of the steam turbine devised by M. Zoelly, of Esher, Wyss & Co., of Zurich, comprises the latter company; the Frederick Krupp Company, the North German Machine Works Company, of Bremen, the Siemens-Schuckert Electric Works, and the United Augsburg and Nuremberg Machine Construction Company, while the Schneider Company, of Creusot, is said to be also included in the syndicate. In contradistinction to the first turbine combination, it is not proposed to form a separate company for the development of the Zoelly turbine, which is claimed to have already yielded satisfactory results in actual working. Each member of the new syndicate is, howevever, empowered to construct this particular type of turbine, and the work will be carried out on a common basis in regard to the utilization of drawings, patterns, etc. Of the members of the syndicate, it may be said that the Krupp Company is largely interested in the question from the marine point of view as a result of the company's ownership of the Germania Shipbuilding Works at Kiel, and the desire to gain practical experience with turbine-equipped steamers.

The North German Machine Works Company is a subsidiary of the North German Lloyd Steamship Company, and its participation is therefore of significance. The Siemens-Schuckert Company is naturally concerned from the standpoint of turbines for electric lighting and power stations, while the Augsburg-Nuremberg Machine Company, which ranks as one of the largest and best established steam engine works in Germany, cannot fail to be interested in a type of engine which is making such progress in various countries. There is very little to say in regard to the developments which are taking place, beyond the fact that both in Europe and America the principal electrical and mechanical engineering firms have become alive to the

*From the "Engineer," London.

posibilities of the steam turbine in the near future. In the United States the Allis-Chalmers Company, which has among its directors Cornelius Vanderbilt and E. H. Gary, of the Steel Trust, is reported to be on the point of embarking upon the construction of steam turbines in competition with the Westinghouse and General Electric Companies, whose turbine systems are both being introduced in Great Britain. But whilst the promotion of turbines is welcome, and will, doubtless, result in a large amount of business, there is, of course, another side of the question, namely, how will this particular business affect the trade in reciprocating steam engines? Herr C. Lueg, president of the Association of German Machine Construction Works, drew a gloomy picture of the outlook for the makers of steam engines and boilers at the annual conference held recently, as a result of the increasing competition of gas engines and steam turbines.

We can, however, scarcely share his pessimism at the present time, seeing that although a few instances exist where the newer types of motors have superseded the old, there is no absolute proof that the total horse power of the steam engines and boilers in use has been reduced, or that a material diminution in the output of new engines and boilers has taken place. What has really happened is, regarded from the total horse-power point of view, that the aggregate demand for power has largely increased, and the latest types of prime movers have obtained a share of this augmentation. Whether a decline in the building of steam engines and boilers will eventally take place is a question which may safely be left to the future to decide. The electric light has not reduced the consumption of gas, nor has the introduction of electric motors made any material difference in the number of small gas or steam engines to be found in different parts of the country.

A Coal-Testing Plant at St Louis.

Among the interesting exhibits connected with the Department of Mines and Metallurgy at the Louisiana Purchase Exposition will be a coal-testing plant operated under the direction of the United States Geological Survey. The tests will be conducted not for the purpose of determining the relative value or merit of different coals, but primarily for the purpose of demonstrating the most economical methods for their utilization.

The testing plant will comprise two standard boilers, a gas producer, coke ovens, washery plant, and two or more briquetting plants. In connection with the boilers one Corliss and one steam turbine engine will be operated, and in connection with the gas-producing plant one explosive gas engine. The power generated by these plants will be utilized for operating the working exhibits in the Mines Building. The testing plant will be located on the ground reserved for outdoor mining exhibits, at a short distance from the Palace of Mines and Metallurgy. The director of the Survey has appointed to conduct this work a committee consisting of Messrs. E. W. Parker, J. A. Holmes and M. R. Campbell.

The equipment for carrying on these tests has been loaned by the exhibitors of the machinery, and Congress has appropriated $60,000 to enable the director of the Geological Survey to make the tests. It is especially provided in the Act of Congress making the appropriation that all the testing machinery and all the coals tested shall be furnished without charge to the Government, the expenditure of the appropriation being limited to the absolute cost of assembling the plant so as to make it conveniently available for the work and the expenses necessarily incurred in its operation. Not only will physical tests be applied, but each carload of coal will be carefully sampled and the composition of the samples determined under the direction of the chemical laboratory of the Geological Survey.

The material to be tested will be collected under the direction of Mr. M. R. Campbell, of the Geological Survey, who will procure the co-operation of the various State geologists. Great care will be exercised to see that the samples sent for testing represent the commercial product of the mines or districts from which the coal is shipped and are not selected samples. No tests will be made of any coals shipped in less quantity than one good-sized carload, as it will require from 8 to 20 tons for each of the different tests to which the coals will be subjected.

The work possesses a peculiar interest from the fact that this Government has not heretofore attempted to make any uniform and comprehensive examination of our mineral fuels. The Governments of Great Britain, Germany, France, and Belgiun have made such examinations and published the results in official reports, which are of great value in securing foreign trade. They have also had an undoubted influence in encouraging the establishment of manufacturing industries in territories accessible to any fuel that is especially adapted to the needs of those industries.

MARCONI'S LATEST EXPERIMENTS.

In Constant Communication With Land in England and America on Voyage to New York.

Mr. William Marconi arrived in New York on Saturday last on the Cunarder Campania, and he informed reporters that all long distance wireless transmission records were broken by his latest apparatus:

"From the day we sailed we were in communication with England or America," said Mr. Marconi. "For 1,700 miles we received messages from Poldhu on the Cornish coast. Then we dropped that station and picked up American stations without trouble.

"None of the American stations has machines like the one I brought with me. If they had we would have picked them up and transmitted our English news from Poldhu to America. There was no hitch in transmitting or receiving.

"The regular Cunard line apparatuses are short distance machines, with a range of 150 miles at most. In two weeks they will be substituted by duplicates of the machine I used on this voyage, and transatlantic wireless Marconi cables will be an assured fact.

"The publication of the transatlantic morning paper will follow. With the new model in every station transmission is beyond question.

"These machines I bring with me are for receiving only. Equally powerful transmission machines can be made, but for the purpose of publishing a newspaper on the ocean they are a success.

"My idea for a mid-ocean newspaper was regarded skeptically by the Cunard people. They wished me to make a personal test. Now on my return voyage I will demonstrate that an ordinary operator can do the work.

"I have contracted to connect our shore stations with the British postal service and to equip twenty new passenger ships.

"My next experiment will be that of girdling the globe by means of instruments on vessels at sea. The British Government has placed several of its warships at my disposal, and the next three months will be devoted to fitting them with the long-distance keys and receivers. Then they will be stationed at different points around the world, and I shall try to pick each one up in succession.

"The only instruments that can take our messages are those keyed up just as ours are, and to do that is so nearly impossible that I say it cannot be done.

"I expect to remain over here only a

week or two, the length of my stay depending on whether I shall have to visit my station in Canada. On my return to England I shall continue the experiments from this side in connection with the Cape Cod station. After that the work will be carried on by the regular operators.

"The instrument to be adopted will be a modification of the best of all that was good in the four types in use. It has a multiplication of my receiver, and will always be in communication with either the eastward or westward shore of the Atlantic, and a ship on which the apparatus is installed will never be out of touch with land."

Mr. Marconi was accompanied by his assistant, Mr. Kemp; two special operators, two secretaries and W. W. Bradfield, who assisted in the experiments during the voyage. Communication was maintained with Poldhu after the Campania had picked up the station on Cape Breton Island.

It is said that the new Marconi news service will cost the Cunard Company $50 per day. Mr. Marconi said that he expected the new ocean news service would be in great demand, and that is why he wished to determine upon a standard receiver.

Clergyman Says He Beats Marconi.

A dispatch from Wilkes-Barre, Pa., May 15, says that Rev. Joseph Murgas, of the Sacred Heart Church of that city, has received notification from Washington that the sixth and seventh patents have been granted him on a wireless telegraphy system he has invented. He says it is better than Marconi's, because it can send and receive messages in half the time. He has been engaged on the invention seven years.

Electric Patent Case Decision.

Judge Bradford, in the United States Circuit Court at Wilmington, Del., handed down a decision in the case of the Westinghouse Electric & Manufacturing Company vs. American Transformer Company. The Judge held that the claim for letters patent 366,362, dated July 12, 1887, issued to George Westinghouse and by him assigned to complainant is valid and has not been infringed upon by the defendant company, and therefore dismissed the bill. The patent relates to an improvement in electrical converters.

Obituary—Andrew Hickenlooper.

Gen. Andrew Hickenlooper, president of the Cincinnati Gas & Electric Company, died in Cincinnati last Friday.

The Edison Medal Competition.

President Arnold, of the American Institute of Electrical Engineers, has addressed to the educational institutions of the United States and Canada a statement with regard to the Edison Medal founded this year, and calling their attention to the fact that it is open for competition by students for the best thesis or record of research on theoretical or applied electricity and magnetism. Mr. Arnold announces that the medal committee of the Institute is being formed and requests the authorities of institutions qualified and desirous to compete to send in their names to the medal committee, at 95 Liberty Street, New York City, on or before June 1, when further information will be given. It is expected that there will a large competition from among the graduating students in electricity.

Society of Chemical Industry.

The last meeting of the New York Section of the Society of Chemical Industry will be held at the Chemists' Club, 108 West 55th street, on Friday evening, May 20. The following papers will be read: "Method for the Rapid Estimation of Boric Acid," by M. F. Schaak; "Notes on Reduced Iron," by A. H. Gotthelf, and "The Hazard from Explosives and Combustibles in the City of New York," by Charles F. McKenna.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 10, 1904.

Electric Railways and Appliances.

759,241-242-243-244. Electric-Railway System. George L. Cragg, Chicago, Ill., assignor to Bion J. Arnold, same place. Filed May 22, 1902.

759,327. Railway Switching and Signaling Apparatus. John D. Taylor, Buffalo, N. Y., assignor to the Taylor Signal Company, same place. Filed Oct. 25, 1901.

759,346. Railway-Block Signal System. Winthrop M. Chapman, Newton, Mass., assignor to the Electric Railway Signal Company, Kittery, Me. Filed May 12, 1902.

759,433. Trolley. Elmer E. Gillingham and Delancey E. Huntley, Wellston, O. Filed April 27, 1903.

759,446. Car-Fender. Frederick R. Keith, Randolph, Mass. Filed June 22, 1903.

759,453. Electric Railway. Timothy Mahoney, San Francisco, Cal. Filed July 1, 1903.

759,543. Electric Railway Signal. Elwood W. McGuire, Richmond, Ind. Filed Aug. 15 1902

759,707. Fender. John O. Harrison, Evansville, Ind. Filed Feb. 8, 1904.

Electric Lights and Appliances

759,506. Means for and Method of Securing Lead-in Wires in Electric Lamps. John C. Entriken and William S. Everett Malvern, Pa., assignors of seven-sixteenths to Charles F. Kindred, Philadelphia, Pa. Filed Jan. 21, 1904.

759,650. Manufacture of Small Incandescent Lamps. Allen D. Whipple, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Dec. 5, 1903.

Electrical Machinery and Apparatus

759,222-223. Power-Transmission Mechanism. Bion J. Arnold, Chicago, Ill.. Filed Feb. 26, 1901, April 26, 1901. Renewed Dec. 13, 1902.

759,237. Circuit-Changer. Charles C. Cadden, Cleveland, O., assignor to the Williams-Abbott Electric Company. Filed June 15, 1903.

759,286. Electricity Meter. Martin Kallmann, Berlin Germany, assignor to the Internationale Electricitats Zahler Gesellschaft, M. B. H., same place. Filed Sept. 28, 1901.

759,288. Electric Brake. Walter Lasar, St. Louis, Mo., assignor of one-half to the Lasar Elevator Company. Filed Feb. 10, 1902.

759,352. Meter for Measuring Electrical Energy. Louis P. Decombe, Paris, France. Filed Nov. 26, 1901.

759,358. Magnetic Separating Apparatus. Thomas A. Edison, Llewellyn Park, N. J. Filed June 21, 1900.

759,426. Electric Soldering-Iron. Sydney Evershed, London, Eng., assignor to himself and Evershed & Vignoles, Limited, same place. Filed Dec. 8, 1903.

759,431. Electric Accumulator. Ricardo Fortun and Eduardo Semprun, Madrid, Spain. Filed Sept. 30, 1901.

759,436. Electrical Warp Stop-Motion for Looms. Henry I. Harriman, New York City, assignor to the American Loom Company, Readville, Mass. Filed Dec. 3, 1901.

759,586. Electric Switch, Henry C. Baer, New York City. Filed Nov. 9, 1903.

759,600. Electrical Switch. Fay L. Faurote, Ann Arbor, Mich. Filed March 14, 1903.

Telephones and Telephone Apparatus.

759,280. Telephone Attachment. Stephen O. Houghton, San Francisco, Cal., and Frank M. Potter, Jr., Syracuse, N. Y. Filed Dec. 30, 1903.

759,316. Telephone-Receiver. Walter C. Runge, London, Eng. Filed Dec. 6, 1902.

759,428. Telephone-Transmitter Hood. Robert D. Fannon, Chicago, Ill., assignor, by mesne assignments, to Delos Dunton, Carpentersville, Ill. Filed Oct. 29, 1901.

759,441. Telephone-Transmitter. Alfred W. Hill, West Hoboken, N. J., assignor to himself and D. P. Chesebro and Alfred E. Davidson, New York City, doing business as the Phonic Carbon Company. Filed Oct. 9, 1902.

759,492. Telephone-Exchange. Clarence A Anderson Salina, Kan. Filed Dec 5, 1901.

759,641-759,762. Signaling Apparatus for Telephone-Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company. Filed Jan. 26, 1903; Sept. 14, 1903.

759,697. Telephonic Apparatus. Alfred Graham, London, Eng. Filed Feb. 4, 1903.

759,741. Electric Block-Signaling and Telephoning System for Railways. Charles G. Otwell and Ira H. Melvin, Laurel, Del. Filed Feb. 11, 1904.

759,771. Signal Apparatus for Telephone-Switchboards. De Witt C. Tanner, Chicago, Ill., assignor to the Western Electric Company, Filed March 27, 1902.

759,836. Generator for Telephone-Calls. Ernest H. Strauss, Chicago, Ill. Filed Nov. 17, 1902.

Miscellaneous.

759,276. Insulator for Telegraph-Wires. Clayton Hobert, Philadelphia, Pa. Filed April 10, 1903.

759,281. Signaling. Gustav A. Huber, Mounthope, N. Y. Filed Jan. 9 1904.

759,464. Alarm System. Felix McGloin, New York City. Filed Dec 31, 1902.

759,472. Thermostat. Alfred Roesch, Bridgeport, Conn., assignor to the Davis & Roesch Temperature Controlling Company, New York City. Filed. Jan. 27, 1903.

759,550. Secondary-Battery Electrode. Charles J. Reed, Philadelphia, Pa. Filed Jan. 16, 1901.

759,701. Facsimile-Telegraph Apparatus. Ernest K. Gruhn, Dresden, Germany, assignor to the Telautograph, Gesellschaft mit Beschraenkter Haftung, same place. Filed Nov. 21, 1902.

759,722. Electric Heater or Rheostat. Max C. Krueger, Chicago, Ill., assignor, by mesne assignments, to the Magneto Electric Company, Amsterdam, N. Y. Filed Oct. 6, 1902.

759,740. Battery, Jay Noble and Edward L. Anderson, St. Louis, Mo. Filed June 1, 1903.

759,796. Lightning-Arrester. John C. Barclay, New York City. Filed Sept. 9, 1903.

759,797. Rheostat. John C. Barclay, New York City. Original application filed Sept. 9, 1903. Divided and this application filed Nov. 18, 1903.

759,798-799. Electrolytic Apparatus. Henry S. Blackmore, Mount Vernon, N. Y. Original application filed July 22, 1903. Divided and last application filed Feb. 23, 1904.

759,814. Door-Lock Actuated Circuit-Breaker. Grayson G. Knapp, Auburn, N. Y., assignor of one-half to Charles S. Averill, Syracuse, N. Y. Filed Feb. 13 1903.

759,825. Wireless-Telegraph Apparatus. Joseph Murgas, Wilkes-Barre, Pa. Filed Oct. 2, 1903.

759,826. Method of Communicating Intelligence by Wireless Telegraphy. Joseph Murgas, Wilkes Barre, Pa. Original application filed Oct. 2, 1903, Divided and this application filed Feb. 24, 1904.

THE TELEPHONE WORLD.

Indiana Independent Telephone State Convention.

The Indiana Independent Mutual Telephone Association will hold its annual meeting at Hotel Lahr in Lafayette, June 28 and 29.

This meeting is sure to be of interest and benefit to both the operating companies, manufacturers and supply people attending. There will be able papers prepared and discussions upon topics of vital interest to all Independent telephone people. The leading manufacturers and supply men will make creditable displays of all lines of goods

There will be a programme of entertainment, such as trolley rides, vaudeville shows, music, an inspection of the electrical and mechanical department of Purdue University, banquet and a dance, all of which will be free to the members attending the convention.

The Sterling Electric Company of that city is extending a hearty welcome to its associates, and says: "We want to see every company in the Independent telephone business in the State of Indiana represented at this meeting, and believe it will be to their interest to be represented. Come, whether you are a member of the association or not. There will be no charges for any entertainment. There will be no assessment, but a 'getting together' of all Indiana telephone men for the purpose of holding a harmonious meeting for the advancement of Independent telephone interests. We appeal to you to come and help make the Independent telephone movement in the State of Indiana the strongest and most united of any State in the Union."

To Oppose the Bell Company.

The Union Telephone Company of California, Pa., was lately granted a franchise to place poles and wires through Roscoe by the borough council. The company will establish an exchange and start an active canvass in opposition to the Bell and Federal telephone companies. The rates for 'phones to be installed by the new company are lower than Federal rates by nearly 35 per cent.

At a recent meeting of the citizens of Junction City, Ky., a company was organized for the purpose of installing a telephone exchange. The following officers were elected: President, Dr. J. R. Steele; vice-president, R. H. West; secretary, J. D. Shelby.

The Pennsylvania Telephone Company is erecting new poles between Hamburg and Windsor Castle. A new telephone line is being constructed from Windsor Castle to Dreibelbis, Virginville, Lenhartsville, Klinsville and Kempton, Pa.

The annual meeting of the Mexican Telephone Company was held in this city last week. C. H. Rollins was ré-elected president and W. French Smith, secretary. There was a single change in the board of directors made necessary by the death of Mr. Brice. The report of Treasurer Smith showed the company to be in a prosperous condition.

The Orfordville, Wis., Tel ephone Company, by O. P. Goorder, president, and T. E. Tollefsrud, secretary, has issued an amendment increasing its capital stock from $10,000 to $15,000.

Home Company in Albany Prosperous.

The annual meeting of the stockholders of the Albany, N. Y., Home Telephone Company was held at the office of the company a short time ago.

At a meeting of the board of directors, held at the conclusion of the stockholders' meeting, the following officers were elected: Howard Hendrickson, president; Irving H. Griswold, vice-president; George C. Lee, Jr., treasurer, and H. J. Prince, Jr., secretary.

The affairs of the company are in a very flourishing condition. The annual report submitted at the stockholders' meeting shows a net increase of 1,159 telephones for the year, or about 100 increase per month, with about 200 contracts on file waiting for installation. New contracts are being received daily. The report also shows that the company, after operating for 15 months, has an earning on stock of 9 per cent. after paying for operating, maintenance and all fixed charges.

Up-to-date Company in Albion, N.Y.

The Home Telephone Company of Albion, which was recently organized, Rochester and Albion capitalists being interested, has commenced work on its new plant, and is anxious to open the service next July with the most modern telephone plant in the United States. One great feature claimed for the new system is private service on all lines, both city and county. This is secured by the use of the "Stromberg-Carlson Selective and Lock Out System."

The signal to central will be the central energy call, similar to the Rochester and Buffalo Independent telephones, discarding the use of old-time hand generators.

The Home Telephone Company of Albion will connect with the Lakeside Company at Waterport, which will give the Albion merchants an equal chance to secure the patronage of the great host of farmers of the Ridge Road, who are now daily in touch with the markets of Medina by the use of Independent telephones. The motto of the Home Telephone Company will be, private service, prompt service, popular service and perfect service. Garrison Babcock, a telephone engineer of Rochester, is in charge of the work and has a large force of men employed.

A suit has been started in Media Pa., by the United Telephone & Telegraph Company to recover $30,000 from the Bell Telephone Company for the alleged destruction of wires during the sleet storm of February 21, 1901. The United Company alleges that the Bell people cut the former's wires, entailing great loss.

The Cooperstown, N. Y., Telephone Company certified to the Secretary of State that it has increased its capital stock from $7,000 to $10,000. The debts and liabilities of the company amount to $1,200.

A company has been formed at Woodburn, Ky., for the establishment of an Independent telephone company at that place.

A complete telephone system is to be installed in Lima, Peru, S. A.

Owego, N. Y., Wants Independent Company.

An Independent telephone company is at tempting to secure a franchise in Owego, for the purpose of putting in a local exchange in that village and operating a line in opposition to the Bell Telephone Company. The petitioners for the franchise are Lyman T. Stanbrough, Ward Decker, Fred Ford and John T. Gorman, of Owego, and Nelson P. Brink, of Binghamton.

The proposition of the petitioners is to form a stock company within 60 days and begin the work of installing the new system at once. The rates promised are for a business place, private line, one year, $28; business place, three party line, $20; residence, private line, one year, $18; residence, three party line, $12.

The Independent telephone in Binghamton is an unqualified success, and those who have the service would not think of attempting to do without it again. One of the things the new company has done is to reduce the telephone rates to such an extent that it is now possible for a person to have both 'phones at about the same price that one cost before the new company came to the field, so that the argument that two 'phones would be necessary does not carry much weight, as it would mean hardly any additional expense.

Many of the best people of Owego are in favor of the granting of the franchise and it is expected that the petitioners will be able to obtain the concessions they desire.

An Independent telephone company is being organized in Pottsville, Pa. The council recently declared the franchise of the existing company forfeited because of alleged violations of its provisions.

Henceforth the Cadiz, Ind., Telephone Company in Henry County will have no business relations with the Bell Company. All business in the future is to be done with the Independent companies.

A new telephone system is being talked up in Georgetown, Mass. The People's Company of Haverhill is interested.

Nearly 600 new telephone companies were organized in Iowa last year.

Telephone Incorporations.

The Rural Telephone Company, Hamlin, N.Y. Capital stock, $5,000. Incorporators; D. Singleton and A. Baase, Hamlin.

The Farmers' Telephone Company of Rensselaer County, Hoosick Falls, N, Y. Capital stock, $5,000. Incorporators: Jay C. Cottrell, Perry S. Pine and John B. Hill, all of Hoosick Falls.

The Keeseville Telephone Company Keeseville, N. Y. Capital stock. $20,000. Incorporators: J. H. A. Bond, J. B. Mace and W. C. Palmer, all of Keeseville.

The Linwood Telephone Company, Linwood, Tenn. Capital stock, $1,000. Incorporators: H. D. Beadle, W. M. Young, J. W. Andrews, A. A. McNabb, T. M. Turner and O. D. Hearn.

The North Collins Telephone Company, North Collins, N. Y. Capital stock, $5,000. Directors: W. M. Ward, D. A. Dillingham and H. G. Parker, of North Collins.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Antigo, Wis.—The plant of the Antigo Electric Light & Power Company here was lately destroyed by fire, causing a loss of $20,000.

Asbury Park, N. J.—It is proposed by the people of this place to install an electric light plant of their own.

Avoca, Ia.—The Avoca Electric Light Company is contemplaing using the meter system.

Colima, Mex.—A company has been organized here with $125,000 capital to generate electric power from the waterfall in the Hacienda de San Antonio. The company will furnish light in this city and for the haciendas in the vicinity. Arnoldo Vogel, owner of the hacienda, can give information.

Culican, Mex.—Carlo Escovar, of this city, proposes to light the city by electricity for a term of 12 years, furnishing 60 arc and also incandescent lamps.

Danville. Ky.—After many years of wrangling the city council has decided to sell a franchise for the installation of an electric light plant.

Fennimore, Wis.—This town has under consideration the establishment of municipal waterworks and an electric light plant.

Jonesboro, Ark—Manager Christy, of the Jonesboro electric light plant, announces that it is to be enlarged.

Moberly, Mo.—The Moberly Light, Power & Fuel Company has been awarded a 10-years' franchise for gas, electric light and power.

Oshkosh, Wis.—William Mainland, of this city, president of the Green Bay Light & Power Company, states that the company is about to double the capacity of its plant and thousands of dollars will be spent in providing new machinery and buildings.

Sebastopol, Cal.—G. W. Sawin has been granted an electric light and power franchise.

Stamps, Ark.—A new electric light plant is to be built here.

Tannersville, N. Y.—The Tannersville Electric Light & Power Company, capitalized at $20,000, has been formed by Charles Penrose, Renwick Dibbell and M. R. Francis, all of Tannersville.

Tazewell, Va.—The Tazewell Electric Light & Power Company has been incorporated with a capital of $10,000 and increased same to $15,000. J. S. Moss is president.

Thomson, Ga.—A system of waterworks and electric lights, to cost not over $25,000, was agreed upon at a recent meeting. James T. Neal, cashier of the Bank of Thomson, has been chosen as chairman, and Paul A. Bowden, cashier of the Farmers & Merchants' Bank, secretary.

West Liberty, Ia.—This city wants a company to furnish electricity for lighting.

Wilton, Ia.—At a special election held here May 2 it was decided to issue bonds to the amount of $5,250 to improve the Wilton electric light plant.

STREET RAILWAYS.

Asbury Park. N. J.—A party of capitalists interested in the proposed trolley road from Freehold to this city, lately went over a portion of the highway to be utilized for the building of the new road which is to run from Freehold to the shore via Colts Neck and Eatontown.

Battle Creek, Mich.—The Battle Creek Electric Railway Company has been incorporated with H. M. Griffin as president.

Cleveland, O.—A large storage battery station will be built in Newburg this summer by the Cleveland Electric Railway Company.

Coldwater, Mich.—The Toledo & Michigan Electric Railroad Company has secured the right of way from Adrian to this city.

Denver, Col.—Electric lines to form a network transportation system to cover the entire northern part of this State will be built, it is said, with the backing of the Burlington Railroad and be feeders for the big system. This will be the first venture of the kind in this section of the country. Two companies have been chartered, one to build from here to Greeley, and the other from Fort Collins to Longmont, where it will connect with the Burlington-Lyons branch.

Elizabeth City, N. C.—D. E. Evans, president of the Elizabeth City Electric Light Company, says that he will organize a company to build an electric railway here.

Geneva, O.—Homer Hood, of Toledo, proposes to build an electric line from this village to the Lake Shore, a distance of five miles.

Hummelstown, Pa.—Work will soon commence on the construction of the Hummelstown & Campbelltown Electric Railway, which will extend from Palmyra to this place.

Jeannette, Pa.—The Jeannette, West Newton & Monongahela Railway Company has arranged to begin construction before the end of the month. The capital is $4,000,000. All rights of way have been secured, and the line will extend across country to the river district of Westmoreland County through a territory with a population of 20,000.

Kansas City, Mo.—R. T. Mastin and G. F. Shields are the promoters of an electric line from Belton, Mo., to this city.

Knoxville, Tenn.—The Knoxville, Traction Company will greatly improve its lines.

Mt. Ayr, Ia.—Wallace Hubbard, an electric railway promoter, of Albany, Mo., will soon be here to make a survey of the proposed electric line from Des Moines to St. Joseph.

Neenah, Wis.—The Wisconsin Traction, Light, Heat & Power Company will build a line to Menasha Park.

Opelika, Ala.—Rush Taylor is the promoter of the electric railway system between this place and Auburn. Every indication points to the early commencement of work on the construction of its line.

Petersburg, Mich.—J. O. Zabel and S. A. Foster have been granted a franchise through Dundee for an electric line from here to Jackson.

Pittsburg, Pa.—The contemplated electric railroad from East Pittsburg to this city, known as the East Pittsburg & Wilkinsburg line, has been franchised.

Salida, Col.—The Chaffee County Electric Light, Power & Railway Company has been incorporated with a capital of $500,000, to construct street railway lines in this city and its suburbs.

Temple, Tex.—The Belton-Temple Traction Company, capitalized at $250,000, has been chartered.

POWER PLANTS.

Ameca, Mex.—George E. McCormick has applied to the State Government for a concession to operate an electric power plant with waters of Las Topenas stream. The power will be used for operating reduction works, which he will erect at his mines in this district.

Granite Falls, Minn.—A company has been incorporated for the purpose of improving the water power at Minnesota Falls, near here, to put in a power house and dynamo, and transmit power to Montevideo.

Marshfield, Wis.—The question of transmitting electricity generated from the large dam recently constructed by the Consolidated Water Power & Paper Company to this city, to light the streets, business houses and residences, is now being seriously considered by the council.

Red Bluff, Cal.—J. H. Leveck has filed notices appropriating 15,000 inches of water from the North Fork of Battle Creek, and for 7,000 inches from South Fork of Battle Creek for the purpose of generating electric power for running machinery.

Salt Lake City, Utah.—The Standard Power Company has in contemplation the erection of a 6,000 hp. electric plant on the Sevier River near Marysvale to furnish power to the mines and mills of the Gold Mountain district, also to supply the camps and towns in Beaver County. E. R. Jones, engineer of the American Geological & Engineering Company, is interested.

BIDS WANTED.

Chicago, Ill.—Sealed proposals are being invited until May 31 for wiring of buildings, furnishing and installing watt and voltmeters, transformers, arc lights and other electric fixtures, and furnishing of necessary current for electric lighting Fort Thomas, Ky., in accordance with specifications and lighting plan to be seen at the office of Lieut. Col. W. H. Miller, Chief Quartermaster, Pullman Building, this city.

Fort Flagler, Wash.—Bids are asked until May 26 for the construction, plumbing, heating and wiring for the electric lighting of a 12 bed hospital here. Address George H. Penrose, Quartermaster.

Washington, D. C.—Sealed proposals will be opened by the supervising architect of the Treasury on May 31, for new magnetic controlling device and new safety devices, etc., for the electric passenger elevator in the United States court house and postoffice building at Scranton, Pa. For specifications address James Knox Taylor, this city.—Mr. Taylor is also inviting sealed proposals until May 26, for the installation of a conduit and electric wiring system for the United States postoffice at Waterbury, Conn.—The bureau of supplies and accounts of the Navy Department is inviting sealed proposals until May 24 for furnishing the navy yards at Puget Sound and Mare Island with a quantity of arc lamps, carbons, incandescent lamps, electric fans and exhausters, transformer, rubber insulated copper wire, conduit and fittings, etc. Bidders can obtain specifications, etc., upon application to the bureau in this city.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, $13\frac{1}{8}$@$13\frac{1}{4}$c.; Lake $13\frac{1}{4}$@$13\frac{3}{8}$c.; casting, $12\frac{7}{8}$@$13\frac{1}{8}$c.

It is estimated that the electrical work on the New York Central Railroad will cost $12,000,000.

The Blue Grass Traction Company of Lexington, Ky., has filed a mortgage to secure $700,000 five per cent. 30-year gold bonds.

The General Electric Company has declared the regular quarterly dividend of $2 a share, payable July 15 to holders of record June 15.

The Turbine Electric Truck Company of New York has filed with the Secretary of State a certificate of increase of capital stock from $100,000 to $300,000.

The directors of the American Railways Company (Philadelphia) have declared a regular quarterly dividend of $1\frac{1}{2}$ per cent., payable June 15 to stock of record May 31.

The directors of the Public Service Corporation decided to pass the semi-annual dividend of $1\frac{3}{4}$ per cent. on the stock of the South Jersey Gas, Electric & Traction Company.

According to President Insull's annual statement sent to stockholders the Chicago Edison Company raised and expended over $3,000,000 of new capital last year and the Commonwealth Electric Company over $2,250,000.

Mason B. Starring has been appointed general manager of the Chicago City Railway. It was declared that the placing of Mr. Starring in the new position marked the beginning of a new policy and important improvements.

The stockholders of the Fairhaven & Westville Street Railway Company will meet at New Haven, Conn., next Friday to vote on a proposition to sell the property and franchises to the Worcester & Connecticut Eastern Railroad Company.

Earnings of the Interborough Company of New York for the quarter ended March 31 amounted in gross to $3,845,121, an increase of $615,000, as compared with the same quarter last year. Net earnings increased $469,000, while surplus after charges, including the dividend on Manhattan stock, increased $35,000.

Judge Gaskill of the Superior Court, Worcester, Mass., has granted a decree allowing Charles M. Thayer and John A. Hall, receivers of the Worcester & Southbridge Street Railway, to sell the road for not less than $300,000 at private sale. It is understood that a syndicate headed by William E. Rice, of Worcester, will purchase the road, together with the allied lines which were involved in the failure last fall.

It is announced that the $3,325,000 of stock authorized at the General Electric Company meeting last week is now offered to stockholders at par, on the basis of one share of new stock for every ten held. Of the amount offered to stockholders, $2,500,000 will be devoted to paying off the floating indebtedness of the Stanley Electric Company and the balance, $825,000, to the general uses of the company. The rights of the new issue of stock figure up at around $5.50.

The directors of the Massachusetts Electric Companies voted to petition the railroad commissioners for authority to issue $8,432,500 in 4 per cent. bonds for the purpose of refunding the present funded debt and $1,227,500 for the purpose of taking up the present floating indebtedness. The total capital stock of the company is $9,660,000 and the outstanding funded debt $8,432,500, the difference representing the additional amounts to be issued $1,227,500.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price May 16
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	$142\frac{1}{4}$
Metropolitan Street Railway	$110\frac{1}{2}$
Metropolitan Securities	76
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	$44\frac{1}{8}$
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	$65\frac{1}{4}$
Philadelphia Traction	$95\frac{3}{4}$
Union Traction, $17.50 paid	$49\frac{3}{4}$
Boston.	
Boston Elevated, full paid	141
West End Street, com	$90\frac{1}{2}$
do. do. do. pref	111
Chicago.	
City Railway	160
North Chicago	70
Union Traction, com	$5\frac{1}{2}$
do. do. pref	30
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	27
do. do. pref	63
Electric Lead Reduction	$\frac{5}{8}$
Electric Vehicle, com	6
do. do. pref	$9\frac{1}{2}$
Westinghouse, com	156
do. pref	194
General Electric	154
Boston.	
Edison Electric Illuminating	$234\frac{1}{4}$
General Electric	$158\frac{3}{4}$
Massachusetts Electric Companies, com	$17\frac{5}{8}$
do. do. do. pref	69
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	147
National Carbon, com	29
do. do. pref	$102\frac{1}{2}$
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	$57\frac{1}{2}$
do. do. do. pref	
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	$124\frac{1}{2}$
Western Telephone Company	$8\frac{3}{8}$
New England Telephone Company	123
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	$1\frac{1}{2}$
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	
Western Union Telegraph Company	$87\frac{5}{8}$
Miscellaneous.	
Chicago Telephone Company	18
Tel., Tel. & Cable Company of America	
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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THE TRADE SUPPLIED BY
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CONTENTS.

EDITORIAL NOTES.

The Convention.

The National Electric Light Association Convention is now in full swing in Boston. There are an unusual number of excellent papers to be read at this year's gathering and the Question Box forms quite an attraction.

As usual the social and entertainment features will be everything that can be desired. The complete programme of the convention will be found elsewhere in this issue.

* * *

Wires to Burn.

As a result of a fire which started in one of the power houses of the Brooklyn Rapid Transit Company the trolley system in the Borough across the river was tied up for over an hour one day last week. Referring to the matter a Brooklyn daily says:

"The cause of all the trouble was a fire which broke out shortly after noon in the cable tower at the Third avenue station. The insulations of the mass of cables through which the heavy current is fed to all the down-town lines became defective and short-circuiting resulted. The fire itself was only a one-alarm affair and was extinguished in twenty minutes."

This burning of the insulation on the cables brings up the question as to why steps have not been taken to compel the Brooklyn Rapid Transit Company to make a move towards placing its innumerable cables and conductors under ground where they belong. We use the expression "make a move" advisedly, for we appreciate the fact that were the above mentioned company compelled to place all of its wires *at once* underground it would probably come very near to going into the hands of a receiver.

In the Borough of Manhattan even a few stray and lonely telegraph wires were recently forced to hide themselves, and yet the city fathers close their eyes to another portion of this great city, where power and other wires are so thick that the residents are obliged to climb to the roofs to ascertain if the sun is shining.

Probably the two greatest extremes in the world in the way of running conductors are to be found in two boroughs of the same city. Manhattan is an example of the modern method, Brooklyn of the ancient.

Brooklyn's wires will have to go underground sooner or later, so a move might as well be made now as five years from now. In order to make it easy, let the city fathers order the wires underground on the installment plan—so many miles a year. This method should not prove onerous to the company, will afford work for the laboring man and make everybody—except possibly the stockholders—happy.

* * *

A Mammoth Undertaking.

At no very distant date the principal railroads in the vicinity of Greater New York will all be obliged to follow the example being set by the New York Central and operate their suburban trains by electricity.

It is stated on good authority that not only will the New York Central make use of electricity in its tunnel as motive power, but that the electric zone will extend as far as White Plains on the Harlem and Ossining or Croton Landing on the main line. When the railroad yards are enlarged (upon which work is now being pushed) they will take in fifty-seven tracks and will extend from Madison to Lexington avenue, and an entirely new distribution of the traffic inward and outward will be made.

The new Grand Central Station, in its

main portico, will be devoted to through train traffic, with twenty tracks. Under this main station will be the suburban system, with from eight to twelve tracks.

The electrification, said Mr. Wilgus, chief engineer of the New York Central, on both the Harlem and Hudson River divisions means extending the electric system from twenty-five to fifty-five miles from the Grand Central Station. The suburban trains will be handled by the multiple unit system, under which every car or two out of three cars will be equipped with electrical motors. Each car is therefore practically self-propelling, so that a single car can be started or fifteen in a train.

For the through trains it has been decided to use electric locomotives, which will be handled with 2,250 horse power engines. The suburban trains will be capable of a speed of seventy-five miles an hour, and it is the intention of the company to eliminate small grade crossings.

The proposed changes will involve an expenditure of about $22,000,000 during the next year.

That the multiple unit system for suburban traffic has a decided advantage over the present system in vogue goes without saying. It should permit of a train of one or two cars being run at much shorter intervals than now, which, as every commuter has found out by experience, is much to be desired. Whether this will be done when the electrification of the road is completed of course depends on the management. It is to be hoped however that it will.

* * *

Radium Causes the Earth's Heat.

Ernest Rutherford, Professor of Physics at McGill University, Montreal, in a lecture before the Royal Institution in London, England, on Friday night, advanced the striking theory that the earth's heat is not attributable to a molten mass which has been slowly cooling for a million years, which has been the generally accepted theory, but to the presence of radium.

A cable dispatch says Prof. Rutherford's address was listened to by a distinguished audience, including Lord Kelvin, Lord Rayleigh, Prof. Dewar and other great scientists.

Prof. Rutherford, in the course of his lecture, stated that the heat in the center of the earth is due to deposits of radium, for the deeper you dig the more radium is obtained.

Prof. Rutherford was the first person to measure the mass and velocity of the electrons of radium. He announced the probability of radium being contained in all matter.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A joint meeting of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers, of Great Britain, will be held in Chicago May 31 to June 3. The headquarters will be at the Auditorium Hotel.

The daily papers are publishing the news that "Nikola Tesla and Prof. M. I. Pupin are jointly working on an invention, which, if successful, will go far toward putting an end forever to warfare. They are, it is said, planning nothing short of a wireless percussion for setting off explosives from a distance."

The General Electric Company is negotiating for an outfit whereby it can communicate between its plants at Schenectady, N. Y., and Lynn, Mass., by means of wireless telegraphy.

Mr. William Marconi, who arrived in New York a week ago after a succesful experiment in talking by wireless telegraphy to both sides of the Atlantic from mid-ocean, sailed Saturday to do more experimenting in Europe on his apparatus. He said that his efforts will be confined to working on an instrument by means of which rapid transmission can be obtained. "At present," he said, "we can send but 30 words a minute. That is a great drawback, and I shall keep at the work until I get something with which I can talk at the rate of ordinary telegraph instruments."

Many thousands of dollars are being invested in electrical machinery for mining coal in Colorado. When electricity is installed fewer men are required to operate the mine and a larger quantity of coal can be hoisted.

Some experiments to determine the influence of radium on the electric spark have recently been made by Prof. A. Stefanini and Dr. L. Magri. According to *Nature* the following results were noted: For discharges between two spheres, or between a positively charged point or sphere and negative disk, the discharge is facilitated by radium for short speaking distances and impeded for longer ones. If the disk is positive and the sphere or point negative, the discharge is impeded at small sparking distances within a limited interval; in general the effect is nil. For certain sparking distances between a sphere and disk it is possible for radium to impede or facilitate discharge according to which electrode is positive.

Several important contributions have been made recently to the fund which is being raised by the American Institute of Electrical Engineers as its share of the expense in securing the ground on which the new engineering building is to be erected in New York. Mr. E. W. Rice, of Schenectady, has contributed $1,000; Mr. Thomas A. Edison, $5,000, and Dr. M. I. Pupin, $5,000. This brings the total fund up to $60,000 at the present time.

A fleet of turbine-driven steamships is to be placed on the Great Lakes by British capital at once. They will make the round trip from Toronto to Port Arthur or Duluth in eight days. The ships will carry 250 passengers and will run at a sustained speed of 16 miles an hour.

Prof. Michael I. Pupin, Ph.D., of Columbia University, recently lectured on "Electric Resonance," before the Department of Electricity, Brooklyn Institute, and said that the subject of electrical resonance had acquired additional impulse in the past eight years, because of its connection with electrical signaling. He recommended students to make first a study of mechanical phenomena of matter in motion, and illustrated his talk by causing oscillation in a steel rod that was fastened to the end of a table. This problem of oscillation was explained, and by the aid of various instruments, run by an electrical machine in the small gallery, it was shown how the principle is carried out to its fulfillment in wireless telegraphy.

Charles T. Yerkes, who arrived from England last week, in speaking about his London underground railway system, said: "The lines in the Metropolitan district, which is the key to our entire system, will be ready for operation by January 1. Our power house is already finished, and the equipment is being supplied as rapidly as possible. The lines of the Metropolitan district have been in operation for 30 years, but the road has always been run by steam. To show what the British investing public think of our stock, I have only to say that it has advanced from 25 to over 40, while consols have, in the meantime, declined from par to under 90."

NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

The following is the programme for the three days' session of the Twenty-seventh Convention of the National Electric Light Association now being held in Boston:

Tuesday, May 24

MORNING SESSION.

Address, President Charles L. Edgar.

Report of Committee on Progress, by Mr. T. Commerford Martin.

"A Three-Wire, 500-Volt Lighting System," by Mr. Walter I. Barnes.

"Luminous or Flaming Arc," by Mr. Welles E. Holmes.

Report of Committee on Standard Candle Power of Incandescent Lamps, by Dr. Louis Bell, chairman.

Report of Committee on Legislative Policy, by Mr. Samuel Insull, chairman.

Report of Committee on Photometric

CHARLES L. EDGAR,
President National Electric Light Association.

Values of Arc Lamps, by Mr. Henry L. Doherty, chairman.

Report of Committee on Uniform Accounting, by Mr. Guy L. Tripp, chairman.

AFTERNOON SESSION.

"A One-Hundred-Mile Transmission Line," by Mr. Robert Howes.

"Grounding the Neutral of High Voltage Generators," by Mr. George N. Eastman.

"Remote Control of Electrical Apparatus," by Mr. William H. Cole.

"The Organization and Equipment of an Arc-Lamp Department," by Mr. Samuel G. Rhodes.

"Electric Heating," by Mr. James I. Ayer.

"Lost and Unaccounted for Current," by Mr. C. W. Humphrey.

Wednesday, May 25

MORNING SESSION.

"Economy in Minor Station Supplies," by Mr. Edgar B. Greene.

"Notes on the Internal-Combustion Engine as Applied to Central Station Service," by Mr. E. E. Arnold.

"Economy Test of a 5,500 Horse-power, Three-Cylinder, Compound Engine and Generator," by Messrs. J. D. Andrew and W. F. Wells.

"The Mechanical Stoker and the Human Operator," by Mr. Edwin Yawger.

Report of Committee on Award of Doherty Gold Medal, by Dr. Schuyler S. Wheeler, Chairman.

Report of Committee on Investigation of Steam Turbines, by Mr. W. C. L. Eglin, chairman.

"Practical Notes on Steam Turbines," by Mr. Francis Hodgkinson.

Thursday, May 26.

MORNING SESSION.

"Electric Light and Power Plants in Connection with Ice Plants," by Mr. C. L. Wakefield.

Report of Committee on Sign and Decorative Lighting, by Mr. Arthur Williams.

Report on Advertising, by Mr. La Rue Vredenburgh.

Report of Committee on Purchased Electric Power in Factories, by Mr. W. H. Atkins, chairman.

Report of Committee on District Heating, by Mr. E. F. McCabe, chairman.

Report on Office Methods and Accounting, by Mr. Frank W. Frueauff.

AFTERNOON SESSION.

"A Proposed System of Standard Instruments for Operating Companies," by Mr. H. P. Davis.

"Single-Phase Power Motors for Electric Lighting Stations," by Mr. W. A. Layman.

Report of Committee on Analysis of Flue Gases, by Mr. Henry L. Doherty chairman.

Wrinkles, Mr. Charles H. Williams, editor.

Question Box, Mr. H. T. Hartman, editor.

EVENING SESSION.

"Types of Large Water Power Installations," with stereopticon, by Dr. F. A. C. Perrine.

Executive session.

KUBEL HYDRO-ELECTRIC POWER HOUSE AND AUXILIARY STEAM PLANT.

BY FRANK C. PERKINS.

Some of the largest hydro-electric plants in Europe find it necessary to install auxiliary steam equipments for helping out during time of low water. A reserve steam plant of 1,000 hp. capacity has been provided at the Elektricitats Werk Kubel, supplying current for from 30 to 50 days when the water power is not sufficient to take care of the existing load. The Kubel hydro-electric plant shown in the accompanying illustrations, Figs. 1 and 2,

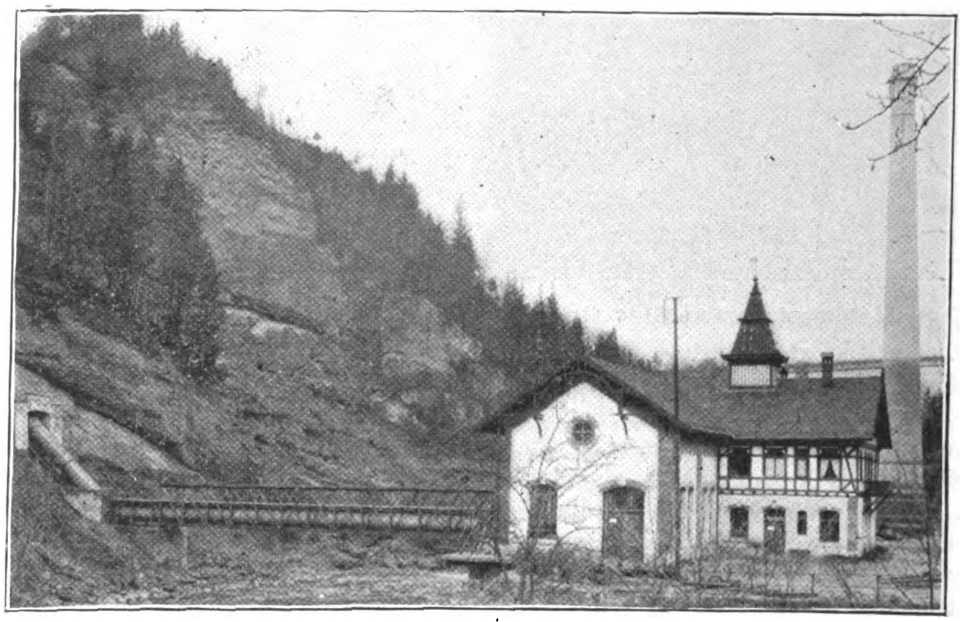


Fig. 1.—Kubel Hydro-Electric Plant

is supplied with water by a steel pipe 294 meters in length, a portion of which is seen in the illustration of the exterior of the power house. The dam is 104 meters long, the thickness at the top being 3 meters and at the base 45 meters. The profile of the hydraulic installation is shown in Fig. 3, while Figs. 4 and 5 show the plan and elevation of the power house.

The hydraulic plant includes four turbine sets of 500 hp. each, and two turbine sets of 1,000 hp. each, while the auxiliary steam plant consists of one vertical compound engine of 1,000 hp. capacity directly coupled to an 850 kw. dynamo operating at a speed of 150 revolutions per minute. The steam engine and the hydraulic turbine were installed by Escher, Wyss & Co. of Zurich, Switzerland, while the electrical equipment

was supplied by the Elektricitats-Actien-Gesellschaft, formerly W. Lahmeyer &

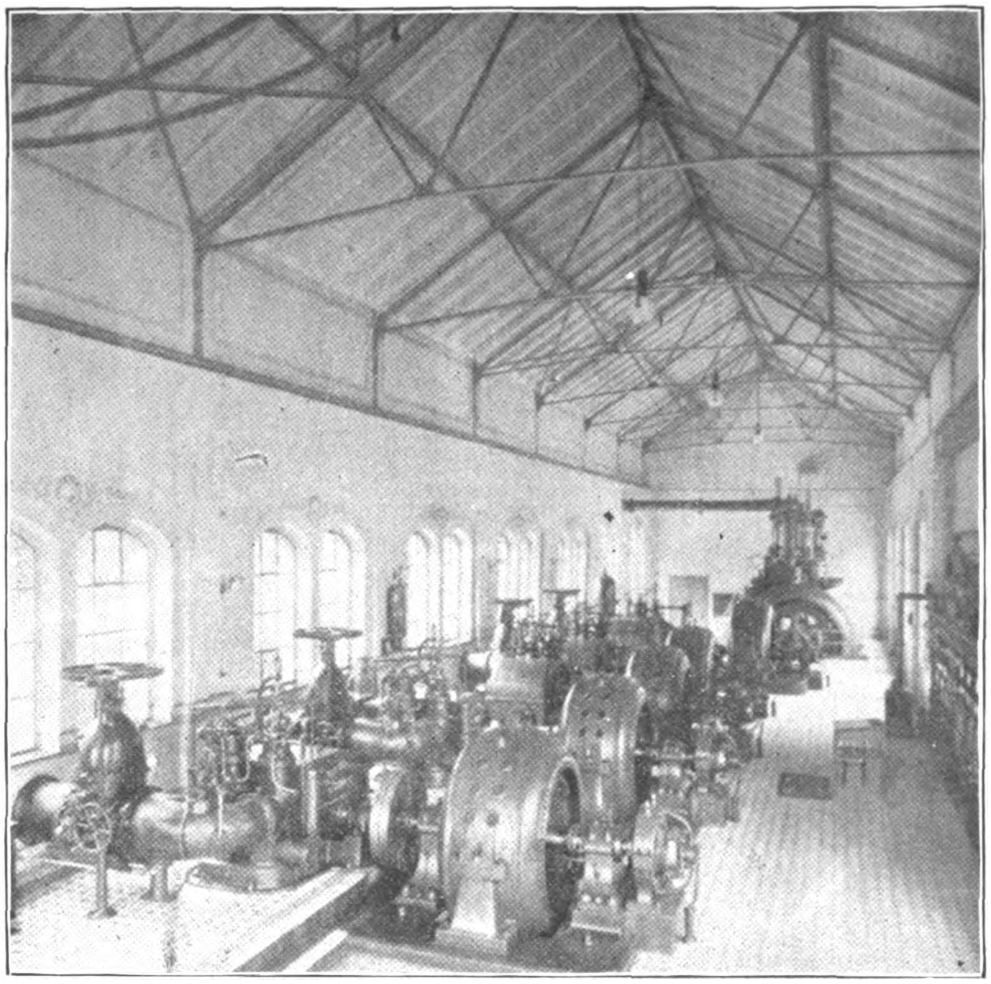


Fig. 2.--Kubel Hydro-Electric Power House and Auxiliary Steam Plant.

Co. of Frankfort, Germany. The 500 hp. hydraulic turbines operate at a speed of 375 revolutions per minute, and are directly coupled to 400 kw. alternators which supply a three-phase current of 10,100 volts directly in the windings of the generator. These machines are of a revolving field type having 16 poles. The outside diameter of the armature is 1,900 mm., while the inside diameter is 1,500 mm., the width being 400 mm. including the ventilating device, while there are in all 96 slots for the winding.

The 1,000 hp. hydraulic turbines are directly coupled to two 850 kw. three-phase machines having 20 poles and operating at a speed of 300 revolutions per minute. One of these machines may be noted in the background in Fig. 2, just in front of the steam driven unit, while the four machines in the foreground are of 500 hp. each. The 850 kw. machine has 120 slots in the armature, the width being 420 mm. and the inner diameter 2,200 mm. while the outer diameter measures 2,670 mm.

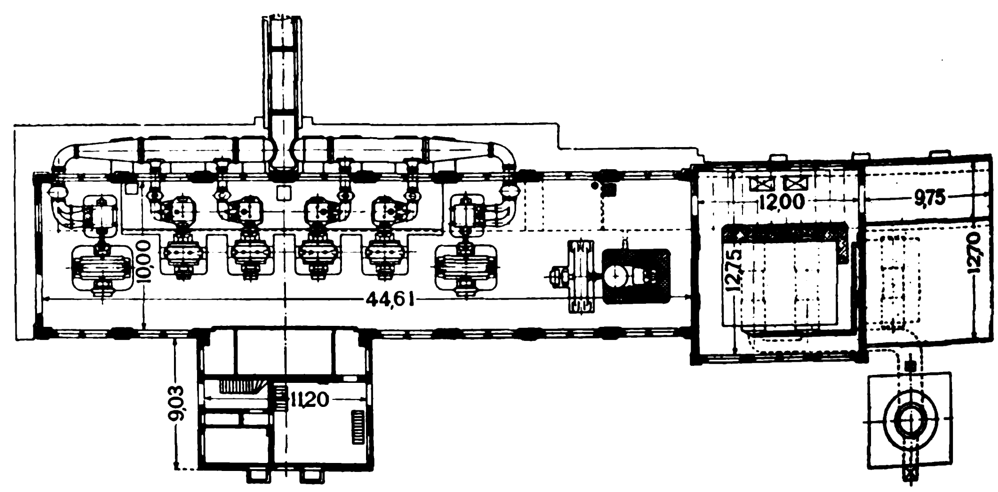


Fig. 4.—Plan of Kubel Power Plant.

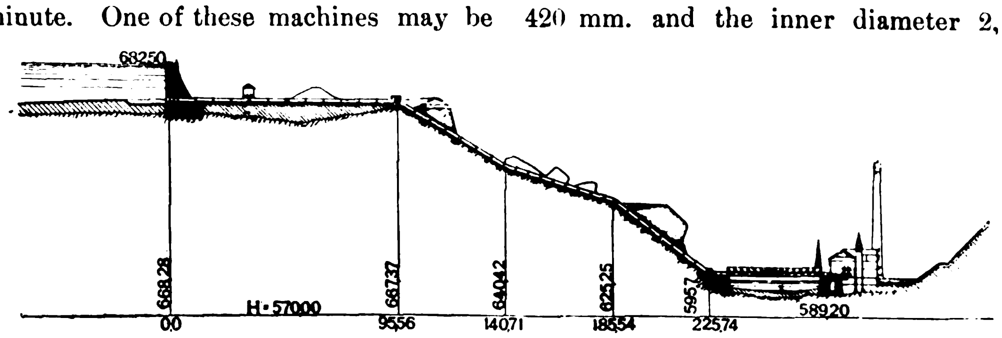


Fig. 3.—Profile of Hydraulic Installation at Kubel Hydro-Electric Plant.

The vertical compound engine has a stroke of 750 mm., the high pressure cylinder having a diameter of 685 mm. and the low pressure cylinder 1,150 mm. It operates at a speed of 150 revolutions per minute and is supplied with superheated steam at 280 degrees. The boiler plant includes two water tube boilers each having a heating surface 270 square meters, and each provided with a superheater of 65 square meters heating surface. The boilers operate at a steam pressure of 10 atmospheres and measure 1.4 meters in diameter and 6.8 meters in length. They are provided with 171 tubes each having an outer diameter of 95 mm. and a length of 5.06 meters. The engine is directly coupled to the revolving flywheel field magnet of the 850 kw. alternator which has 40 poles. The armature has 240 slots and is 330 mm. wide. The inner diameter of the armature is 3.2 meters and the outer diameter is 3.6 meters, while the total outside measurement of the generator is 4,200 mm. The exciter for this unit is a multipolar direct current dynamo mounted on the outside of the main bearing of the alternator.

The current is transmitted by overhead lines at a pressure of 10,000 volts and is transformed at the sub-station to 550 volts for the secondary power circuit and to 125 volts for the lighting distribution. The current is sold for power purposes at the rate of 400 francs per horse power per year for a small machine, 275 francs per horse power per year for machines of 10 hp. capacity, and at 180 francs per year for motors of 50 hp. or over.

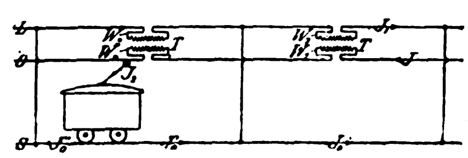
Heligoland's Lighthouse Searchlight.

The searchlight in the lighthouse tower at Heligoland, which was referred to some time ago in these columns, is of a novel type, according to the *Model Engineer and Electrician*. The lamp consists of three arc lights, reflecting mirrors, and projector regulating devices 120 degrees

apart, all operated automatically. Thus three beams of light are thrown simultaneously from the top of the tower.

EARTHED RETURNS FOR ALTERNATE CURRENT RAILWAY WORKING.

In a contribution to the *Elektrotechnishe Zeitschrift*, Dr. Behn-Eschenburg discusses the fall of potential in earthed rail returns when alternating currents are employed, and the means available for reducing this leakage, or its effect upon telegraphs and telephones using earth returns. A remedy which at once suggests itself consists in the choice of a periodicity for the current by which the instruments are not influenced. The effect of the self-induction of the track rails increases the loss for higher periodicities with the same current. It would, therefore, seem advantageous to reduce the periodicity to a minimum. At the same time it is well known that the human ear is not susceptible to the vibrations set up by low periodicities, so that disturbance as far as the telephone is concerned could be easily avoided. On the other hand, the relays used for the telegraphs, signal bells, and telephones on railways are especially sensitive to these low periodicities, and consequently liable to be affected by the same. The human ear is capable of detecting vibrations from about 16 to 16,000 periods per second. The mean periodicity of the vibrations produced by the voice is about 400, while the alternating currents in vogue employ periodicities of from 16 to 60. The vibrations due to the commutator segments of direct current machines used for working tramways range from 500 to 1,000 per second. To the fact that these vibrations approximate in number those produced in speaking, is due the comparatively marked disturbance of telephone apparatus by tramways worked with direct current. The author goes on to describe in detail some experiments carried on in the laboratory attached to the Maschinenfabrik Oerlikon in order to determine the effect of different periodicities on different telegraph and telephone apparatus. He then proceeds to deal with the practical means available for preventing leakage from earthed returns. One of these consists in the system introduced by the Maschinenfabrik Oerlikon, whereby the current in the track rails is transferred to an auxiliary conductor, the track rails in fact only carrying the return current over a short section upon which the moving train happens to be, being for the rest conveyed by the auxiliary conductor. The advantages offered by such an arrangement over an insulated return may be called into question. A decisive answer is found in the simplification enabled by the use of the wheels of the train as collectors. The arrangement is shown diagrammatically



herewith. Parallel to the track rails, S, in which the fall of potential is to be compensated, an auxiliary conductor, L, is provided electrically bonded at intervals with the track rails. By means of these connections the track rails and auxiliary returns are divided into a number of linked sections. In certain of the sections of the auxiliary conductor the secondary windings, W_2, of ordinary transformers are placed, whose primary windings, W_1, are connected in series with the overhead conductor, O. Several possible modifications of this arrangement are referred to by the author, who also enters into the theory of its working, showing the ratio which should exist between the dimensions of the windings, W_1 and W_2. He points out, incidentally, that a transformer should be used whose self-induction is very high compared with the non-inductive resistance of a section of the auxiliary return, and that an EMF. must be generated by this transformer equal to the fall of potential over the section. The total loss of pressure in the overhead conductor is thereby increased by the amount lost in the auxiliary return. In conclusion, the author gives the results of some careful experiments with the system, showing that a reduction in proportion to the total current of $\frac{4}{100}$ can be made in the current conveyed by the track rails. That is to say the current in the track rail can be reduced to one twenty-fifth of the total. This device is not unlike, in principle, the negative boosters used in the return current feeders of direct current lines.—*Electrical Engineer, London.*

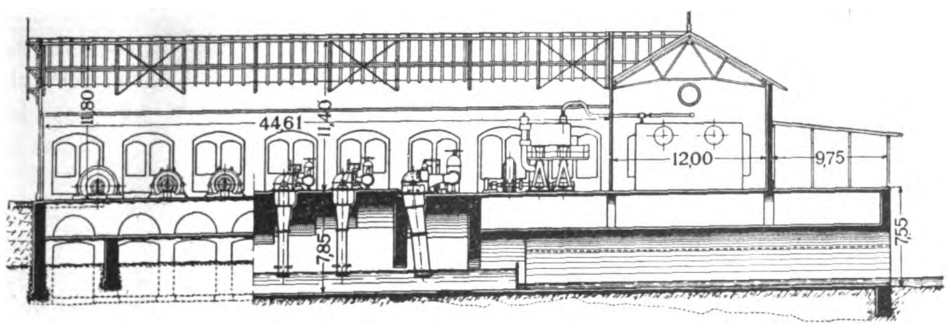


Fig. 5.—Elevation of Kubel Hydro-Electric Power House.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE II.

BY W. H. WAKEMAN.

In order to make a series of articles on this subject complete it is necessary to explain the terms used, so that readers may fully comprehend their meaning and application.

The tensile strength of a boiler plate means the number of pounds or tons that is required to pull a bar 1 inch square, made of this plate, into two pieces. This is not altogether a theoretical calculation, but is the result of a test made on a piece of the plate in question. It is not practical to take a bar of this metal 1 inch square, for this test, therefore a much smaller piece is taken and tested, then from the total pull required, and the sectional area where fracture occurred, it is possible to tell the stress required to part a bar one inch square.

For illustration suppose that a piece of

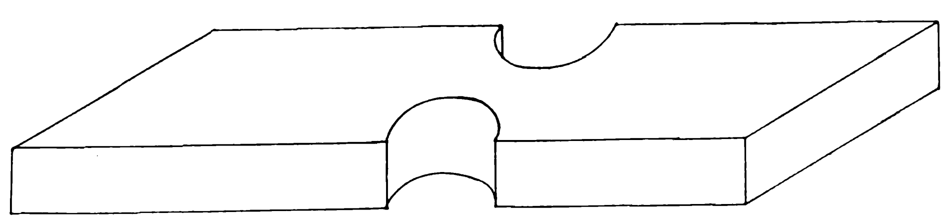


Fig. 1.

plate ½ inch thick is taken and reduced in section as shown in Fig. 1 until it is ½ inch wide at the smaller part. The sectional area at this point is $.5 \times .5 = .25$ square inch. Suppose that it parted under a stress of 15,000 pounds. This is to be multiplied by a number obtained by dividing 1 by the area of test piece. Then $1 \div .25 = 4$ and $15,000 \times 4 = 60,000$

pounds, which is the tensile strength of the plate in this case.

English rules and formulas sometimes state the tensile strength in tons. If it is desired to apply these to a case where the strength is given in pounds, divide by

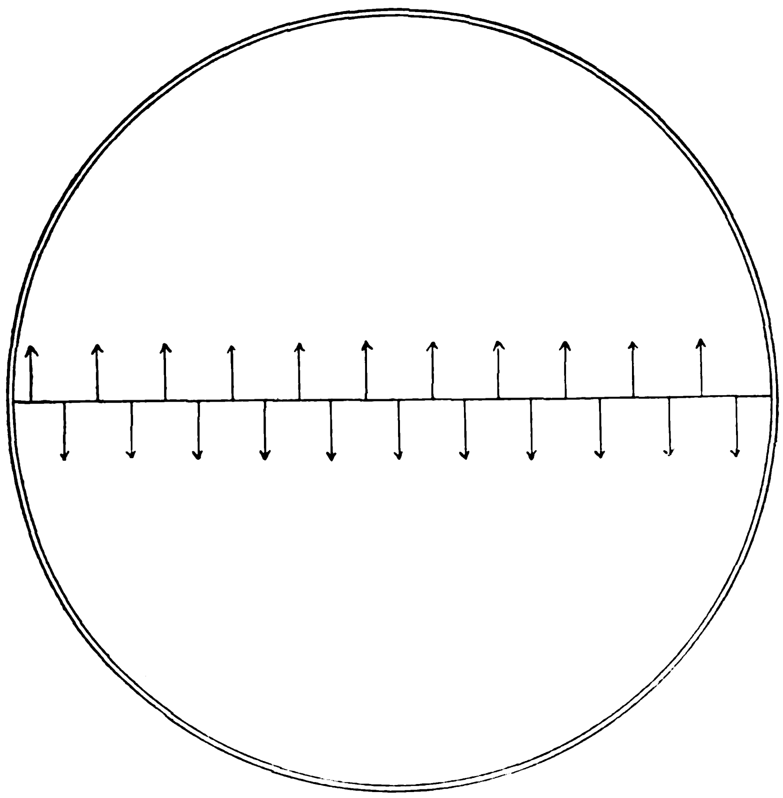


Fig. 2.

2,240 and the quotient is in tons. This is mentioned in order to prevent confusion in regard to the kind of ton that is meant.

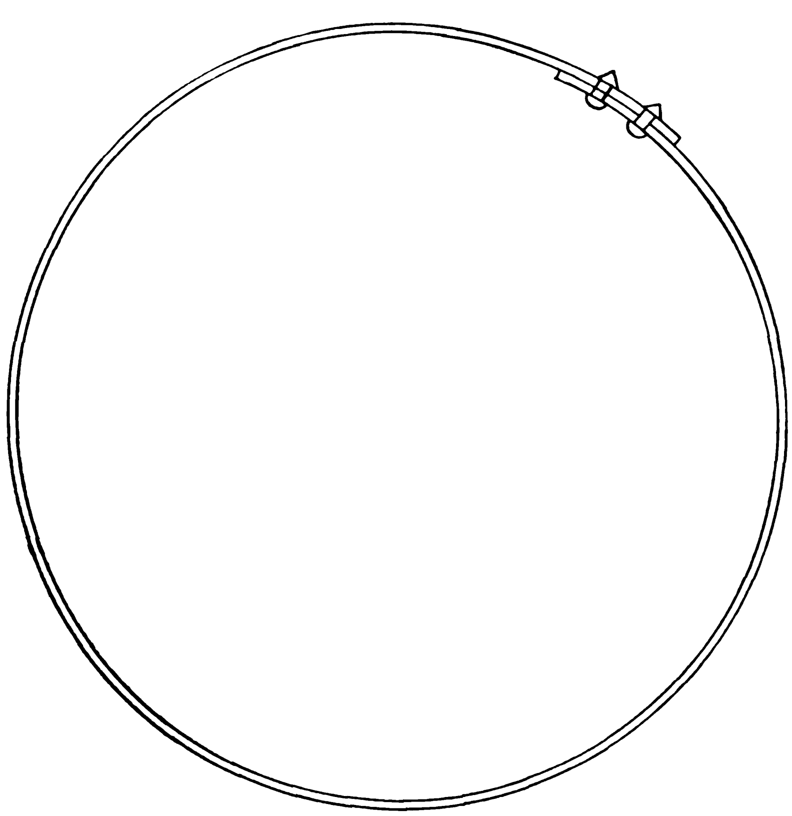


Fig. 3.

In the above case it is 60,000 ÷ 2,240 = 26.78 tons.

If the plate is to be located so that the greater strain will come lengthwise of the grain, then the test piece should be tested in that way, but where the strain is to come across the grain, care should be taken to have the test piece fairly represent this condition. This is important because in the latter case the tensile strength is less than in the former. Where the shell of a tubular boiler is made in two plates, the grain lies lengthwise of the boiler, hence the greater strain is applied across the grain, and this is one objection to the two plate boiler. The thickness of plate is a factor because plates for stationary boilers are usually much less than 1 inch thick, therefore the thickness in decimals of an inch accounts for the material to be depended

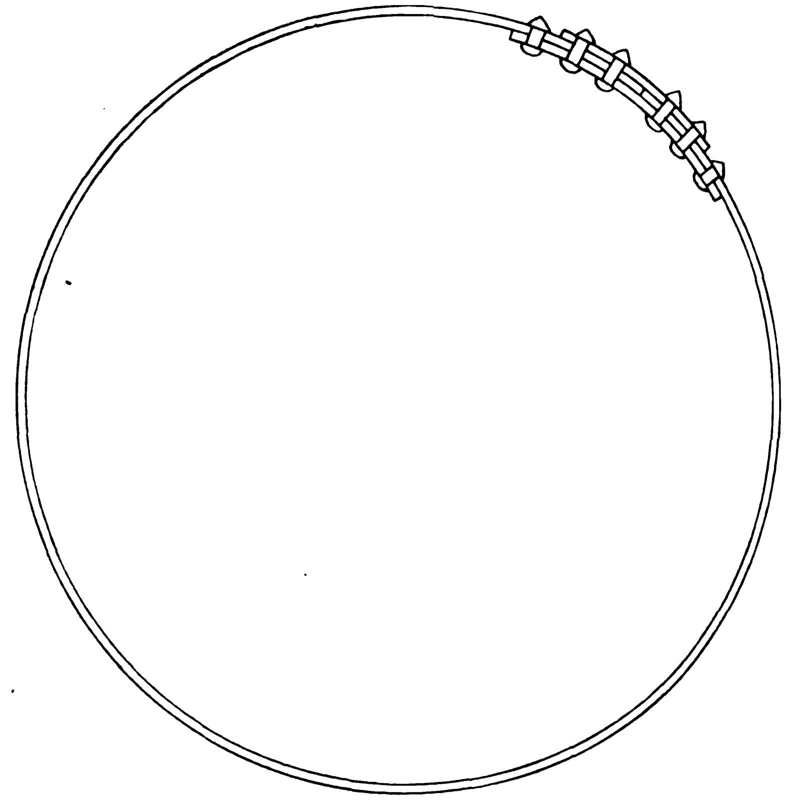


Fig. 4.

upon. When the strength of a boiler shell is calculated, a strip 1 inch wide is assumed to represent conditions which apply to the whole, but this is not mentioned in the formulas because multiplying by 1 does not change the value of a factor. The strength of riveted joint, stated as a decimal fraction, is used because such a joint in always weaker than the solid plate. This of course operates to reduce the actual strength, as a structure of any kind is no stronger than its weaker part. It is taken into account in every rule or formula given for determining the safe pressure, but it is not always stated in the same way, hence the real fact is sometimes overlooked by readers who do not study the subject.

As I have fully explained and illustrated the comparative strength of riveted joints of many kinds in previous issues of this paper, no extended notice of the subject is required here, but brief reference to it is proper.

The circle in Fig. 2 represents a ring of solid plate. If plates could be welded so as to be equally strong at every point, it would eliminate this factor, or, in other words, the fraction would be raised to 1, thus having no effect on the remainder of the calculation, but this is not practical in the present state of the art.

Fig. 3 represents a plate containing a

double riveted joint of ordinary design, which has about .70 of the strength of Fig. 2. Fig. 4 shows a ring from a plate containing a superior form of joint which has about .90 of the strength of Fig. 2.

The diameter of boiler is taken into account because pressure acts at right angles to a line drawn through the larger part of shell at a given point. This is illustrated in Fig. 2. It is true that pressure acts on every part of the circumference, but only the diameter is used, for this when multiplied by the pressure per square inch gives the strain on the two sides of shell at both ends of the straight line in Fig. 2. Some rules take the whole diameter and both sides of the shell, while others only take the radius or one-half the diameter and one side of the shell, but the result is the same.

The factor of safety is fully explained in the preceding chapter. Briefly stated it represents the proportion of estimated ultimate strength of shell that it is safe to depend on in every day practice. It is the only factor in the calculation that is left to the judgment of the calculator, for although it is arbitrarily stated in some cases, and given with many modifications in others, there is nothing to prevent the substitution of any other that may seem advisable.

A NEW PORTABLE CAPILLARY ELECTROMETER.

BY L. RAMAKERS.

Mr. S. W. Y. Smith, M. A., demonstrator in physics, Royal College of Science, London, recently presented to the Physical Society of London a new portable capillary electrometer, the principal advantages of which over other types existing, are as follows: The liability to get out of order is reduced to a minimum; the liquids being completely inclosed, the instrument can be carried about freely, evaporation of the elecrolyte is prevented and adjustments to different degrees of sensitiveness are made very easily. The pneumatic key, free from appreciable thermoelectric effects, and requiring no attention, greatly facilitates the observation of minute electromotive forces by means of the capillary electrometer; keys of the kind described can be used in measurements in which the electrometer is not employed and form convenient commutators, make-and-break keys, etc. They can be worked at a distance with certainty, and, engaging very little of the observer's attention, allow almost undivided observation of deflections, etc., arising from changes of contact produced by their means.

The instrument presented by Mr. Smith is a modification of the form of capillary electrometer represented in Fig. 1, and consisting of two wide tubes joined across by a capillary tube which is cylindrical, and may be horizontal or may slope upwards at any angle from b towards a. The apparatus contains mercury and sulphuric acid of about maximum conductivity, distributed roughly as shown. A spring key, like that represented in the figure, is commonly used with the instrument, and keeps the platinum terminals P_1 and P_2 at the same potential unless the lever S is depressed. When the lever is depressed

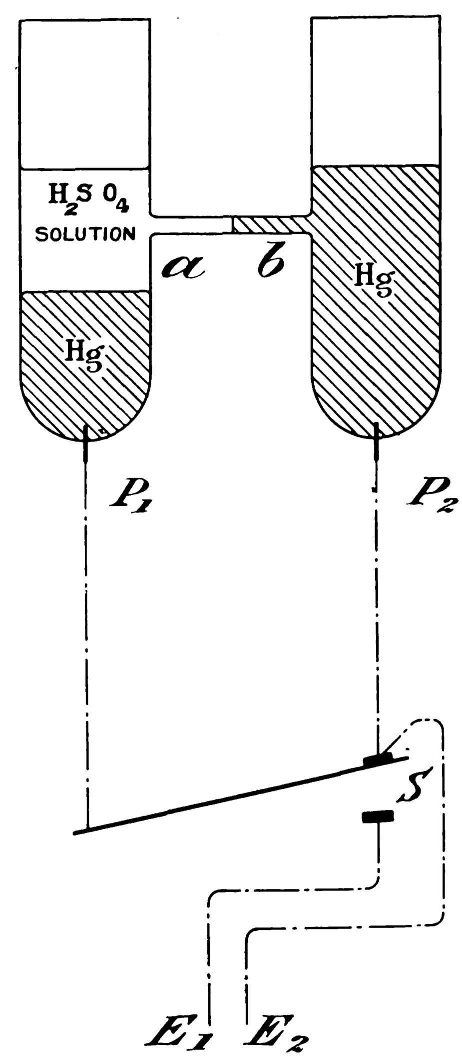


Fig. 1.

the potentials of the terminals become E_1 and E_2, which may, for example, be the potentials of two points in a potentiometer circuit. It is the function of the instrument to determine whether these potentials are the same or different.

The nature of the modifications made in the present electrometer is shown in Fig. 2. To prevent evaporation of the sulphuric acid solution, without preventing free motion of the liquids within the apparatus, the wide tubes are closed at the top, but are joined across by another tube opening into them as shown. With this arrangement the apparatus is made air tight, and can, if desired, be made air free by exhaustion of the apparatus before sealing. The apparatus contains approximately enough mercury to completely fill one limb, and about half as much sulphuric acid solution. By suitably adjusting the distribution of the mercury and the solution in the two limbs, the apparatus can be arranged for use with the capillary tube either horzional or tilted upwards at a considerable angle.

The distribution of the mercury can be altered most easily by means of a crosspiece provided with a top as represented in Fig. 2 by dotted lines. When the top is open there is free communication between the mercury in the two limbs, and the relative amount in each can be altered by tilting the apparatus. When the top is closed the two quantities of mercury are insulated from each other.

The usual spring key has several disadvantages. Thus, if it is made of brass, the contacts frequently become unsatisfactory through surface tarnishing, and if, to avoid this, the bearing surfaces are made of platinum, the key sometimes shows pronounced thermoelectric effects. Further (and this is a point of some importance in a portable instrument), the key cannot conveniently be fastened on to the same stand as the rest of the instrument, for, unless the stand and the support on which it rests are very rigid, the pressure necessary to depress the spring produces sufficient movement of the meniscus, by change in the inclination of the capillary tube during the act of depression, to render the detection of minute changes of surface-tension impossible.

The mercury key, represented in Fig. 2, is free from these disadvantages. It consists, as shown, of a U-tube closed at one end and communicating at the other with a pneumatic-pressure ball and containing mercury in the bend. Three platinum wires are fused into the tube and connected as shown. It is obvious that the same change of contacts is produced by squeezing the ball B, as by depressing the lever S in the spring key. The mercury in this key takes the place of the lever in the spring key, and the two different contacts between it and E_1 and E_2 respectively are here quite definite and practically independent of the amount of pressure exerted upon the ball B. Further, the contacts are not exposed directly to the laboratory atmosphere. The thermoelectric effects are very small since the changing contacts take place between platinum and mercury which are almost identical thermoelectrically. The warmth

communicated to the key from the hand of the operator can be neglected, and the heat produced by the compression of the air in the key need only be very small. The key can be fixed to the same stand as the rest of the apparatus, for even if the pressure which changes the contacts is applied as suddenly as possible the maximum vertical pressure upon the stand is only a few grams, whereas in the case of the spring key it may be 500 grams or more.

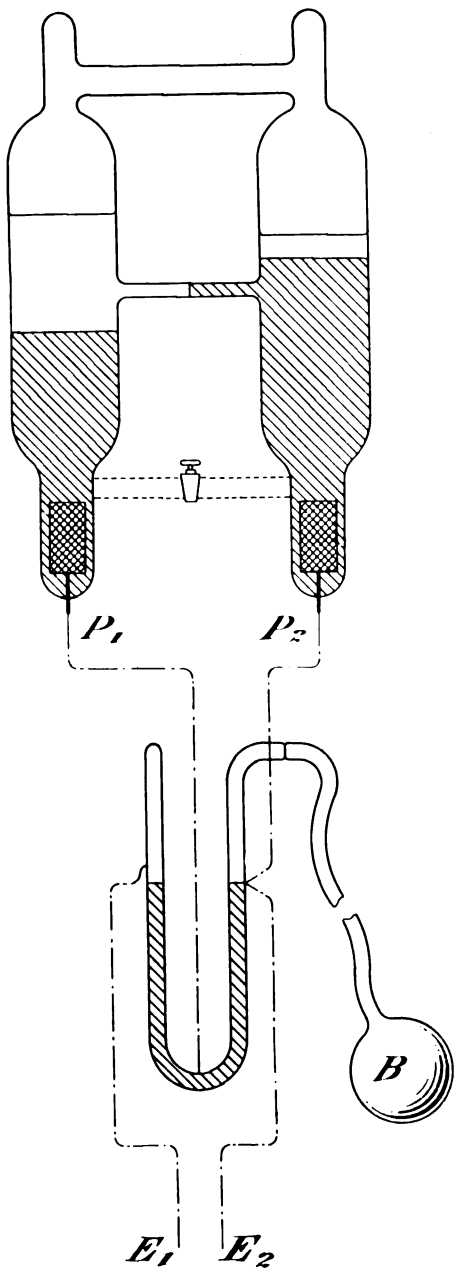


Fig. 2.

By adjusting the length of the mercury column in the key so that it is only slightly less than the length of the U-tube between the two extreme platinum wires, the change of potential at P_1 from E_2 to E_1 and conversely, can be made almost instantaneously. Hence measurements can be made with the instrument even if the zero is altering fairly rapidly. With a key of this kind it is also obvious that the observation of the meniscus through the microscope can receive a very near approach to undivided attention.

Commutators and keys which make a set of connections in a prescribed order can be constructed on the same principle as the pneumatic key described. Fig. 3 represents a combined commutator and electrometer key.

The U-tube to the left is the key already described, and the double U-tube to the right is the commutator. The positions of the different wires are so arranged with request to the levels of the mercury that it requires greater pressure to change the contacts in the double U-tube, than in the tube to the left. The first effect of pressure is to throw the electrometer into the potentiometer or other circuit. connecting P_1 with E_1 and P_2 with E_2. On increasing the pressure, the connections

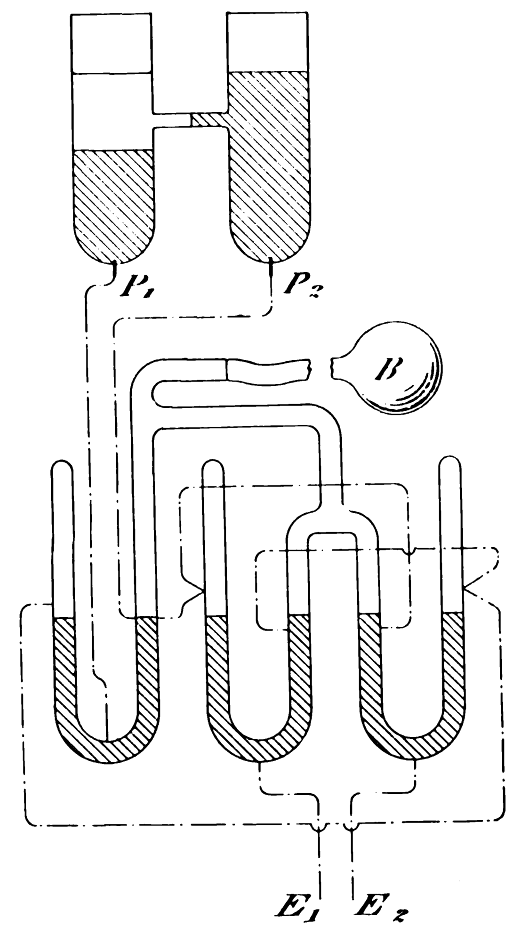
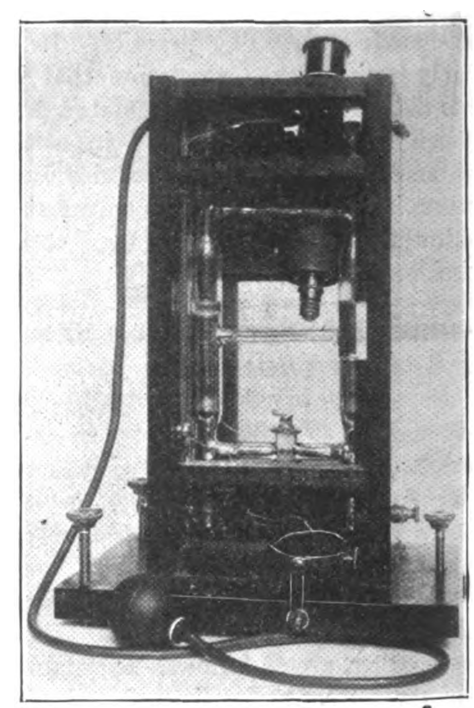


Fig. 3.

in the double U-tube are reversed and P_1 is connected with E_2 and P_2 with E_1. Hence, when the contacts change in the commutator, we get a motion of the electrometer meniscus corresponding to approximately twice the difference of potential between E_1 and E_2, and so, in this way, the sensitiveness of the instrument is doubled.

The sensitiveness of the electrometer, using the simple key first described, is such that when the diameter of the wide tubes is about 1 cm. and the diameter of the capillary is about 1 mm., a movement of the meniscus perceptible with certainty in a microscope magnifying 100 times is produced by a potential difference equal to 0.0001 volt. The actual extent of the movement is somewhat variable, and amounts usually to about 0.01 mm.

The sensitiveness of 0.0001 volt, which is obtainable without any difficulty if the mercury is clean, is sufficient for a great many measurements in which the electrometer can be employed, and for these the electrometer (which for the purpose in question is really a surface-tension galvanometer) is more convenient than an ordinary galvanometer with a suspended magnetic system. The electrometer is much more easily set up than an ordinary galvanometer. There is no suspension, no lamp and scale, and, practically, no leveling; but it is advisable when working with the instrument that the potential of E_1 should never be more than a few tenths of a volt less, or more than about



A New Portable Capillary Electrometer.

a volt greater, than the potential of E_2. These conditions of working are, in general, not difficult to satisfy. If the potential-differences applied exceed either of the limits previously mentioned, it is sometimes necessary to run some of the mercury through the capillary tube in order to get the instrument again into its best working order.

The accompanying photograph represents one form of the instrument described. The arrangement of the different parts will be obvious from the description already given. The illumination of the end of the mercury thread is effected by means of a concave mirror attached to the base of the instrument.

THE STEAM TURBINE AS APPLIED TO ELECTRICAL ENGINEERING.*

BY THE HON. CHARLES A. PARSONS, F.R.S.; G. GERALD STONEY AND C. P. MARTIN.

In the early days of electric lighting the speed of dynamos was far above that of the engines which drove them, and therefore belts and other forms of gearing had to be resorted to. To make a high-speed engine, therefore, was of considerable importance, and this led to the possibilities of the steam turbine being considered. It was, however, at once seen that the speed of any single turbine wheel driven by steam would be excessive without gearing, and in order to obtain direct driving it was necessary to adopt the compound form, in which there were a number of turbines in series, and thus, the steam being expanded by small increments, the velocity of rotation was reduced to moderate limits. Even then, for the small sizes of dynamos at that time in use, the speed of revolutions was high, and therefore a special dynamo had to be designed. Speaking generally, an increase of speed of a dynamo increases its output, and therefore it was obvious that such a high speed dynamo would be very economical of material.

These considerations led in 1884 to the first compound steam turbine being constructed. It was of about 10 hp. and ran at 18,000 revolutions per minute, the diameter of the armature being about 3 inches. This machine, which worked quite satisfactorily for some years, is now in the South Kensington Museum.

Before, however, this first turbo dynamo was constructed, a set of preliminary experiments were commenced with the view of ascertaining, by actual trial, the conditions of working equilibrium and steady motion of shafts and bearings at the very high speeds of rotation that appeared to be essential to the construction of an economical steam turbine of moderate size. Trial shafts were run in bearings of different descriptions up to speeds of 40,000 revolutions per minute; these shafts were 1½ inches in diameter and 2 feet long, the bearings being about ⅜ inch in diameter. No difficulty was experienced in attaining this immense speed, provided that the bearings were designed to have a certain small amount of "give" or elasticity, and after the trial of many devices to secure these conditions, it was found that elasticity combined with frictional resistance to transverse motion of the bearing bush, gave the best results, and tended to damp out vibrations in the revolving spindle. This result was achieved by a simple arrangement; the bearings in which the shaft revolved was a plain gun-metal bush with a collar at one end and a nut at the other; on this bush were threaded thin washers, each being alternately larger and smaller than its neighbor, the small series fitting the bush and the larger series fitting the hole in the bearing block, these washers occupying the greater part of the length of the bush. Lastly, a wide washer fitted both the bush and block, forming a fulcrum on which the bush rested, while a spiral spring between the washer and the nut on the bush pressed all the washers tightly against their neighbors. It will be seen now that, should the rotating shaft be slightly out of true (which it is impossible to avoid in practice), the effect is to cause a slight lateral displacement of the bearing bush, which is resisted by the mutual sliding friction of each washer against its neighbor. The shaft itself being slightly elastic, tends to center itself upon the fulcrum washer before mentioned; and under the gyrostatic forces brought into play by the rapid revolutions of the shaft and influenced by the frictional resistance of the washers, the shaft tends to assume a steady state of revolution about its principal axis, or the axis of the mass, without wobbling or vibration. This form of bearing was exclusively used for some years in turbine engines aggregating some thousands of horse power, but it has since been replaced by a simpler form fulfilling the same functions. In this latter form the gun-metal bush is surrounded by several concentric tubes fitting easily within each other with a very slight lateral play; in the interstices between the tubes the oil enters, and its large viscosity when spread into thin films has the result of producing great frictional resistance to a rapid lateral displacement of the bearing bush; the oil film has also a centring action, and tends, under vibration, to assume a uniformity of thickness around the axis, thus centring the shaft, and, like a cushion, damping out vibrations arising from errors of balance. This form of bearing has been found to be very durable and quite satisfactory under all conditions.

These first turbine engines consisted of two groups of 15 successive turbine wheels, or rows of blades, on one drum or shaft within a concentric case on the right or left of the steam inlet, the moving blades or vanes being in circumferential rows projecting outwardly from the shaft and nearly touching the case, and the fixed or guide blades being similarly formed and projecting inwardly from the case and nearly touching the shaft. A series of turbine wheels on one shaft were thus constituted, and each one complete in itself is like a parallel flow water turbine; the steam, after performing its work in each turbine, passing on to the next, and preserving its longitudinal velocity without shock, gradually falling in pressure as it passes through each row of blades, and gradually expanding. Each successive row of blades was slightly larger in passage way than the preceding to allow for the increasing bulk of the elastic steam, and thus its velocity of flow was regulated so as to operate with the greatest degree of efficiency on each turbine of the series.

About 1890, however, an account of the temporary loss of control of the patents, the radial flow type of turbine was reluctantly adopted, and this was in 1892 arranged to work condensing, and a 100 kw. plant driving a 2,000 volt single-phase alternator at 80 periods, which ran at 4,800 revolutions per minute and therefore was two-pole, when tested by Prof. Ewing was found to take only 27 lbs. per kilowatt-hour, with 100 lbs. steam pressure moderately superheated to about 70 degrees F. and with 27 inches vacuum, a result comparable with the best obtained by reciprocating engines at that time, and thus a wide field was opened up for the use of the steam turbine as a prime mover. Many of these plants, mostly of 150 kw., were made for electric lighting stations.

In 1894, on the recovery of the original patents, the parallel flow type was reverted to, with considerable improvements in design calculated both to increase the economy and decrease the cost of manufacture. Instead of the steam entering at the center and expanding both ways, one set of blades was replaced by a set of dummy pistons which were substituted for them, in which a grooved piston or dummy on the spindle ran close to but not in contact with corresponding grooves in the cylinder, thus making a practically steam-tight and yet frictionless joint. The bearings also were made of the later type, with several concentric tubes. At the same time the system of blading was greatly improved, giving a more perfect form of blade, and one also with much greater mechanical strength than in the original formation.

A good vacuum is of great importance in a turbine, as the expansion can be carried in the turbine right down to the vacuum of the condenser, a function which is practically impossible in the case of a reciprocating engine, on account of the excessive size of the low-pressure

*Abstract of paper presented before the British Institution of Electrical Engineers, May 12, 1904.

cylinder and also of the ports, passages and valves which would be required. Thus in a turbine the benefit derived from a good vacuum is much more than in a reciprocating engine, every 1 inch of vacuum between 23 inches and 28 inches affecting the consumption on an average about 3 per cent. in a 100 kw., 4 per cent. in a 500 kw., and 5 per cent. in a 1,500 kw., the effect being more at high vacua and less at low. It is thus seen how a good vacuum is of importance in a turbine plant, and in this regard it may be well to look into the conditions necessary for obtaining the same. The first point is to avoid all air leaks, and this is easily accomplished in a turbine plant, as there are no packed glands and stuffing boxes to leak. The only places where leakage of air is possible are where the turbine spindle comes out of the cylinder, and here leakage of air is rendered very small by packing the glands with steam, so that any leakage which takes place is steam and not air. The next is to have a suitable condenser, and in this regard sufficient area must be allowed by suitable arrangements of the tubes, and also ample way for the steam between them for proper velocities of the water in the tubes, sufficient supply of cooling water and efficient means of cooling the condensed water so as to keep the air-pump cool, and full provision for extracting by the air-pump and other means the inevitable small quantity of air which must leak in. By attention to these requirements it is unnecessary to increase the size of the condenser beyond that used in ordinary practice, so that in the case of the most recent condensers for steam turbines from 10 to 12 lbs. steam is condensed per square foot per hour; and at this rate of condensation, vacua of from 27½ inches to 28 inches, with barometer 30 inches, can be obtained at full load. The amount of cooling water generally allowed is about 50 times the full-load steam consumption, which will increase the vacuum under normal conditions by about ¾ inch or 1 inch over that obtained by the usual 30 times the steam used. If we allow 14 feet total head on the circulating pump due to lift, and for friction in the pipes and condensers, etc., which in most cases is excessive, especially where the return pipe is sealed, with 50 times the steam consumption in a plant taking 18 lbs. steam per kw. hour, and assuming 50 per cent. efficiency in the pump and motor, the power used by the circulating pump is only 1 per cent., and with circulating water 30 times the steam consumption it would be 0.6 per cent., a difference of only 0.4 per cent., such a small difference as not to be comparable with the gain of 4 per cent. to 5 per cent. in the turbine by the use of increased circulating water.

With regard to extracting the air, a great improvement has been effected by the use of a vacuum augmentor which has been recently introduced. In it the air-pumps are placed about 3 feet below the bottom of the condenser. From any convenient part of the condenser, preferably near the bottom, a pipe is led to an auxiliary condenser, generally about one-twentieth the cooling surface of the main condenser, and in a contracted portion of this pipe a small steam jet is placed which acts in the same way as a steam exhauster, or the jet in the funnel of a locomotive, and sucks nearly all the residual air and vapor from the condenser and delivers it to the air-pumps. A water seal is provided to prevent the air and vapor returning to the condenser. Thus if there is a vacuum of 27½ inches to 28 inches in the condenser, there may be only about 26 inches in the air-pump, which therefore need only be of small size, the jet compressing the air and vapor from the condenser to about half or a little less of its original volume. The small quantity of steam from this steam jet, which is only about 1½ per cent. of that used by the turbine at full load, together with the air extracted, is cooled down and condensed by the auxiliary condenser, which is generally supplied with water in parallel with the main condenser. In this connection it should be observed that condensation in a condenser takes place much more rapidly and effectually if the air is thoroughly extracted than if there is much air present, as the air seems to form a blanket round the tubes and retards the steam getting to them.

In steam turbines the governing is effected either by a centrifugal governor of a well-known type, which keeps the speed constant, or by a core sucked into a solenoid to keep the voltage constant. In most cases, however, the centrifugal is preferable, especially where there are large changes of load, as in traction work, and it is also preferable where alternators have to run in parallel. In either case the governor moves a small relay plunger which regulates the steam, admitted to a relay, which in turn actuates the main admission valve, generally of the balanced double-beat type. The exhaust from the steam relay is utilized for the steam packing the end glands. Thus the governor having only to move the small plunger has very little work to do, and therefore can be made very sensitive. The sensitiveness is still further increased by keeping the whole governor gear in slight movement by connecting one of the pivots of the levers with a cam. These movements are so rapid as not to affect the even turning movement of the turbine. For parallel running of alternators, an even turning movement is of great importance, and this makes the turbine specially suitable for the driving of alternators. It might be thought that there would be difficulty in making alternators driven by reciprocating engines parallel with turbines, and vice versa, but in no case has the running not been satisfactory, and in some the turbines have been found to steady the reciprocating engines.

In the design of dynamos and alternators to be coupled to steam turbines, special regard is to be paid to the large centrifugal force to be encountered. Diameters have to be kept down, and excessive surface speed must also be avoided. Since, then, the diameter has to be small, the length must be increased in proportion and a long core is the result, with moderate diameter, the contrary of slow-speed machines. At the same time, on account of the higher surface speed, the pitch of the poles is greater, thus giving more ampere-turns per pair of poles than is usual. In alternators this gives no trouble at all, as all that has to be provided is sufficiently strong field magnets to overcome the reaction of the armature, and sufficient magnetic resistance to allow of strong field magnets. This extra magnetic resistance can be given either in the air-gap or by saturation of the poles as may be found desirable. These large poles also conduce to diminish magnetic leakage, and as a result very good regulation can be obtained. In low-voltage alternators rotating armatures are preferable, as the iron and copper losses are much less, especially where there are only two or four poles, but rotating armatures, although satisfactory for 500 to 2,000 volts, have not been found suitable for the higher voltages of 6,000 and 10,000 which are now common, and therefore rotating fields and fixed armatures have been adopted in many of the recent alternators. For continuous-current dynamos the same remarks apply, only here sparkless commutation has to be provided for. Carbon brush blocks cannot be used, as at these speeds the brushes are apt to vibrate, and so diminish the intimacy of contact and cause heating and undue wear. The result is that it has been found best to form the brushes of wire, gauze, or foil, preferably of brass, and these must be sufficiently flexible so as to main-

tain a good contact with the commutator over the whole section of the brush. It follows, therefore, that the properties of the carbon brush blocks in giving sparkless commutation without alteration of the lead of the brushes, cannot in turbine-driven dynamos be utilized, and other means must be adopted to secure sparkless commutation at varying loads. One way is to shift the brushes automatically according to the change of load and this can be effected by connecting the brush gear to a steam cylinder controlled by a spring and supplied with steam from the point where the steam enters the turbine. At this point the pressure of the steam is proportional to the load of the dynamo, and therefore the piston in the steam cylinder being controlled by a spring takes up a position proportional to the load and thus shifts the brushes to the point of sparkless commutation. Another method is to provide commutating poles as proposed by Prof. Ryan and others, but the best method is to provide compensating winding as proposed by Prof. Forbes, Deri, etc. By these means, with the improvements recently adopted, absolute sparkless commutation can be secured with fixed brushes, up to, in plants for traction purposes, 100 per cent. overload.

Electrical Association Formed in North Dakota.

The organization of the Electrical Association of North Dakota was perfected in Grand Forks recently, with J. S. Leary of Valley City, president; J. S. Fuller of Larimore, secretary, and Thomas Roycraft of Grand Forks, treasurer. The next meeting will be held in Fargo in October.

New York Electrical Society.

The 243d meeting of the Society will be held at the Havemeyer Building, Columbia University, Wednesday evening, May 25. There will be a business meeting at 7:45, and at 8 o'clock Dr. M. I. Pupin will lecture on "Selective Signaling by Electrical Resonance." Dr. Pupin will explain the principles and the essential elements of this system of transmission. These elements are: The multi-frequency alternator, the transmitter, the distributors, the resonators and the rectifiers. At the special request of the U. S. Patent Office Commissioner, Dr. Pupin has prepared an exhibit for the pavilion of the U. S. Patent Office, at the St. Louis Exposition, illustrating by a complete model the transmission of telegraphic messages by alternating currents of various frequencies, the receiving and the transmitting apparatus being electrically tuned to the frequencies which they are intended to receive and transmit. This exhibit will be shown at the lecture. The lecturer will discuss at some length the application of electrical resonance on which the development of wireless telegraphy may so largely depend.

Removal.

The Bullock Electric Manufacturing Company has removed its New York offices to the Empire Building, No. 71 Broadway.

PERSONAL MENTION.

Mr. Harry J. Clark, chief engineer of the Syracuse (N. Y.) Rapid Transit Company, has been appointed assistant to President and General Manager C. D. Beebe, of the Rochester, Syracuse & Eastern Road and the Auburn & Syracuse Electric Road. He will have an active part in the construction of the new road connecting Rochester and Syracuse, which will be built this summer.

Mr. E. H. McHenry has been elected as fourth vice-president of the New York, New Haven & Hartford Railroad Company. Mr. Mellen, president of the road, says that Mr. McHenry is particularly well versed in the adaptation of electricity to standard gauge railroad operation and that his services are particularly desired in this direction.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 17, 1904.

Electric Railways and Appliances.

759,876. Trolley Wheel and Harp. Frank W. Garrett and Joseph D. Forrer, Johnstown, Pa., assignors, by mesne assignments, to the Westinghouse Electric & Manufacturing Company. Filed Dec. 26, 1901.

760,079. Trolley. Frank A. Overdier, Columbus, O. Filed June 30, 1903.

760,145. Guard for Trolley-Wheels. Charles O. Phillips, Kalamazoo, Mich., assignor of one-half to Hiram C. Streeter, same place. Filed March 2, 1904.

760,159. Electric Block-Signal System. Tony Silvene, Victoria, Canada. Filed May 29, 1902.

760,163. Trolley-Catcher. Irwin W. Smith, Dayton, O. Filed Jan. 25, 1904.

760,184. Trolley Pole-Head. Robert I. E. Dunn, Dallas, Tex. Filed Aug. 29, 1903.

760,223. Electric Railway. Thomas D. Lovell, Beverly, Mass., assignor of one-half to Robert M. Bailey, Deadham, Mass. Filed Jan. 22, 1904.

760,231. Trolley-Base. Peter D. Milloy, Buffalo, N. Y. Filed Nov. 16, 1903.

760,325. Electric Railway. William R. Fearn, Camden, N. J. Filed Dec. 16, 1903.

760,330. Trolley-Pole. James Furgason, Montour Falls, N. Y. Filed May 28, 1903.

Electric Lights and Appliances.

759,880. Electric-Arc Lamp. Otto Gross, near Manchester, Eng. Filed Dec. 11, 1903.

759,904. Regulating Apparatus for Theatrical Electric Lighting. Ernest F. Moy and Percy H. Bastie, St. Pancras, London, Eng. Filed Dec. 11, 1903.

759,925-926. Bracket for Electric Lights. Theodore Smith, Chicago, Ill. Original application filed July 27, 1903. Divided and last application filed Dec. 22, 1903.

759,962-963. Plural Lamp-Socket. Reuben B. Benjamin, Chicago, Ill., assignor to the Benjamin Electric Manufacturing Company, same place. Filed Dec. 9, 1901, and July 18, 1902.

760,376. Electric-Lamp Cluster. Reuben B. Benjamin, Chicago, Ill., assignor to the Benjamin Electric Manufacturing Company, same place. Original application filed Dec. 9, 1901. Divided and this application filed Nov. 12, 1902.

Electrical Machinery and Apparatus

759,873. Power-Transmission Device. William Evans and Paul W. Knauf, Philadelphia, Pa.; said Evans assignor of his right and said Knauf assignor of one-half of his right to said William Evans, John H. Evans and Robert Evans, Philadelphia, Pa., trading as John Evans' Sons. Filed Oct. 17, 1903.

759,915. Electric Switch. Max von Recklinghausen, New York City, assignor, by mesne assignments, to the Cooper Hewitt Electric Company. Filed April 22, 1902.

759,941. Plug-Receptacle for Electric Circuits. John H. Trumbull, Plainville, Conn., assignor to the Trumbull Electric Manufacturing Company, same place. Filed Oct. 9, 1903.

759,967. Alternating-Current Motor. Alexander J. Churchward, Brooklyn, N. Y. Filed March 29, 1897.

759,981. Electric Cable. Johannes Frisch, Mulheim-on-the-Rhine, Germany, assignor to Felten & Guilleaume Carlswerk Actien-Gesellschaft, same place. Filed May 5, 1902.

760,035-036-037. Steam-Turbine. Johann Stumpf, Charlottenburg, Germany, assignor to the General Electric Company. Filed Sept. 8, 1903.

760,077. Electrical Switchboard. Ernest W. Muller, Brooklyn, N. Y., assignor to Hubert Krantz, same place. Filed Nov. 20, 1902.

760,081. Automatic Switch-Indicator. Dewey S. Rice, Weatherly, Pa. Filed Dec. 24, 1903.

760,086. Dynamo-Electric Machine or Motor. Imle E. Storey, Amsterdam, N. Y. Filed Sept. 15, 1903.

760,091. Automatic Regulator for Electric Circuits Montgomery Waddell, New York City. Filed June 18, 1903.

760,160. Power-Transmitting Device. Clement Smith and Terry Stafford, Topeka, Kan. Filed Dec. 26, 1903.

760,209. Circuit-Controller. Paul H. Jaehnig, Newark, N. J., assignor to the Electric Motor & Equipment Company. Filed March 1, 1904.

760,289. Electrical Apparatus for Working Reciprocating Tools. Alfred D. Williamson and Cecil L. Sumpter, Sheffield, Eng., assignors to Vickers Sons & Maxim, Limited, same place. Filed Jan. 31, 1903.

760,387. Electric Switch. Egbert R. Dull, Chicago, Ill. Filed Aug. 5, 1901.

760,400. Automatic Oil-Switch. Max von Recklinghausen, New York City, assignor to the Cooper Hewitt Electric Company. Original application filed April 22, 1902. Divided and this application filed Jan. 6, 1904.

760,408. Dynamo-Electric Machine Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed June 1, 1903.

Telephones and Telephone Apparatus

760,143. Apparatus for Amplifying or Reinforcing Telephone-Currents. Joseph J. O'Connell, Chicago, Ill., assignor to the American Telephone & Telegraph Company. Filed Aug. 22, 1903.

Miscellaneous.

759,910. Electric Separator. Alonzo H. Perry, St. Louis County, Mo. Filed Feb. 28, 1903.

759,987. Facsimile-Telegraph Apparatus. Ernst K. Gruhn, Dresden, Germany, assignor to the Telautograph, Gesellschaft mit Beschraenkter Haftung, same place. Filed Nov. 20, 1902.

760,012. Electric Self-Registering Target. Theodore F. Oetjen, Augusta, Ga. Filed April 14, 1903.

760,023. Apparatus for the Electrolytic Refining of Metals. Alfred Schwarz, New York City, assignor to the General Metals Refining Company, same place. Filed Nov. 22, 1902. Renewed Nov. 20, 1903.

760,029. Telegraph-Sounder. John F. Skirrow, East Orange, N. J. Filed Jan. 8, 1904.

760,057. Process of Electrically Smelting Materials. Alfred H. Cowles Cleveland, O. Filed Oct. 20, 1903.

760,075. Electrical Resistance. George I. Leonard, Pasadena, Cal. Filed Oct. 27, 1902.

760,076. Electric Heater. George I. Leonard, Pasadena, Cal. Filed Jan. 22, 1903.

760,096. Protecting Device for Vapor Electric Apparatus. James R. Baker, Arlington, N. J., assignor to the Cooper Hewitt Electric Company. Filed Nov. 6, 1903.

760,119. Means for Protecting Vapor Electric Apparatus. Peter C. Hewitt, New York City, assignor to the Cooper Hewitt Electric Company. Filed Dec. 22, 1903.

760,234. Electric Cab-Signal. Edward McClintock, Merriam Park, Minn., assignor of two-thirds to F. E. Butler and Edward Mierke, St. Paul, Minn. Filed Sept. 5, 1903.

760,280. Electric Water-Heater. Richard Toennes, Boonville, Mo. Filed Jan. 27, 1904.

760,281. Electric Alarm. Herbert Trull, Fernie, Canada. Filed Sept. 17, 1903.

760,315. Combined Electric Heater and Battery. Jesse R. Davis, Parkersburg, W. Va., assignor of one-third to Charles A. Wade, same place. Filed Dec. 8, 1903.

760,399. Selective Signal System. Fred C. Penfield and Olin Templin, Lawence, Kan. Filed March 17, 1902.

THE TELEPHONE WORLD.

Covington, Tenn., Without Telephone Service.

Because the city authorities imposed a tax of $1.50 per pole on the Cumberland Telephone Company which holds no franchise in Covington, the company has stopped its service and that city is no longer able to talk over the wires. The company feared that if it paid the tax other towns would make it do the same thing. The Memphis Telephone Company is arranging to install an exchange.

The New England Telephone & Telegraph Company will, within a few weeks, proceed to install a farmers' telephone system in Oxford, Mass., connecting the farms by wire with the outside world. It is probable that a farmers' telephone exchange will be established to include subscribers in Oxford, Sutton, North Oxford, Howarths, Buffums and the eastern section of Charlton, with headquarters in Oxford.

The Kinloch Long Distance Telephone Company of Missouri, according to St. Louis dispatches, has authorized an issue of $5,000,000 twenty-five year 5 per cent. gold bonds, of which $1,000,000 are to be placed at once. The mortgage covers all the lines of the company in Missouri, Kansas, Illinois and Indiana,

The People's Rural Telephone Company has met its first drawback in Clayton, Pa. The borough council has held up an ordinance granting privileges because of a disagreement on the height of poles.

The Round Top, Purling & Cairo Telephone Company of Cairo, N. Y., is a new concern, with the following directors: W. L. Richards, J. B. Edgerly and N. H. Griffin, all of Cairo.

The work of pole setting by the Hamilton, O., Home Telephone Company is completed through Venice, and the workmen are now nearing Shandon.

The Chesapeake & Potomac Telephone Company is contemplating the installation of a telephone system at Benwyn.

The German Independent Telephone Company of Gage County, Neb., has increased its capital stock to $5,000.

The Citizens' Telephone Company will install automatic 'phones in its Traverse City and Battle Creek, Mich., exchanges soon.

The Farmers' Interstate Telephone Company is installing about 50 'phones in the neighborhood of Lane, Ill.

A movement is on foot to establish a telephone company at Philadelphia, Miss., representing an investment of $10,000.

The Summerfield, Telephone Company of Noble County, O., capitalized at $5,000, has been formed.

The Farmers' Independent Telephone Company has been granted a franchise to enter the village of Upper Alton, Mo.

The Stryker, O., Telephone Company has increased its capital stock from $10,000 to $15,000.

Cost of Operating Automatic Telephones.

The Automatic Telephone Company of Chicago, whose stock is extensively held in Wilkes-Barre, Pa., and which operates under the Strowger patents, has issued a statement showing the comparative cost of operating with a manual telephone apparatus as compared with that of operating with an automatic system. The statement is made up from actual results obtained in the city of Grand Rapids, Mich., which used a manual board for six years, and in January, 1904, installed automatic apparatus manufactured by the Automatic Electric Company.

With 5,125 telephones in service in November, 1903, on the basis of one month's cost of operation with the manual board, the total cost per year was $51,024--147 people being employed. For the month of March, 1904, with 5,507 telephones in service and the automatic system in use, a total of 35 people were engaged, and the cost for the month was at the rate per annum of $26,292, or a saving of $24,732 in favor of the automatic system, the services of 112 persons being dispensed with. In both cases the cost of repairs and renewals was eliminated from the statement.

Citizens' Company of Columbus, O., Increasing Lines.

Work of extending the lines of the Citizens' Telephone Company was lately commenced on the viaduct. It will be pushed as rapidly as possible on both the north and east sides, and when completed, probably in January, 1905, over 4,000 new telephone connections with the central station will have been provided.

Most of the cables will be in conduits. While the underground and overhead work is being pushed the work on the company's new building, adjoining its present structure at Third and Long streets, will be rushed equally as fast and a new automatic switchboard installed, so that both will be finished about the same time.

The facilities of the company will almost be doubled when the plans under consideration are finally carried out. To make the improvements mentioned will necessitate an expenditure of nearly half a million dollars.

Many of the heavy cables that are now on the poles in the districts to be covered by the new conduits are to be taken down and placed in the conduits.

The Seneca County, N. Y., Home Telephone Company has connected its line with Geneva and now announces a long distance service to all points west, while in Waterloo and Seneca Falls it has extended its line until there are 108 'phones in Seneca Falls and 123 in Waterloo. It is extending its lines throughout the country.

Thomas Parmalee and Bert Pollock, president and superintendent of the Plattsmouth, Neb., telephone system, are working for the connection of the Plattsmouth and Lincoln systems.

The Bucyrus, O., Telephone Company has completed a new telephone circuit through Ridgeton, which will be known as the Ridgeton line.

Weather Reports by Telephone for Farmers.

The residents of 13 counties in Northern Ohio are being supplied daily, including Sundays and holidays, with weather reports from the United States bureau in Cleveland.

The reports are sent out at about 10 A.M., from the weather bureau office in that city, to the United States Telephone Company and from there they are telephoned to each town within the 13 counties. This is of especial benefit to the farmers and fruit growers.

The telephonic system of distributing the weather reports was started first in Iowa. It has been a success there. Forty thousand farmers receive the reports daily, besides the special frost and storm warnings. The reports thus reach the people who are interested several hours earlier than can be done by the use of mails.

The Pleasant Prairie, Wis., Telephone Company is reported to have notified the Wisconsin Telephone Company, with which it is now connected under a sub-lessee's contract, that it has elected to rescind the contract. If this is true it means that the Pleasant Prairie Company has decided to accept the offer of the Citizens' Telephone Company to purchase the small company at the price of $1,600.

The South Bethlehem Telephone Company was lately incorporated in Albany, N. Y., with a capital of $2,000 to operate a telephone system between South Bethlehem, Selkirk, Cedar Hill and Coeymans. The directors are E. C. Palmer, Charles D. Niver and J. R. Davidson, of South Bethlehem, and Newton B, Vanderzee, John W. Mosher, John B. Mosher and John F. Vrooman of Selkirk.

News from West Farmington, N. Y., states that the Pleasant Valley Telephone Company held its annual meeting a short time ago. The accounts were audited and it was found that after paying all bills there was quite a surplus in the treasury. The officers were re-elected for another year with the exception of treasurer, which office was filled by Frank Weeks. The line is to be extended and better service rendered than heretofore.

Rural telephones will soon connect all parts of Sonoma County, Cal. A franchise, was applied for by residents of the Two Rock and Penn Grove sections at a recent session of the board of supervisors. Six different systems have been installed during the past two months.

The farmers in the neighborhood of Okolona, O., a little village about six miles west of Napoleon, have formed a Farmers' Mutual Telephone Company, and ordered a 100 drop switchboard. J. W. Durham is president.

The net output of the American Telephone & Telegraph Company for the month of April decreased 366 instruments as compared with the same month last year.

There is soon to be established in Akron, N. Y., a Citizens' Telephone Company. The capital will be $10,000. Most of the stock has been taken by residents of that village.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Addison, Mich.—This town wants electric lights.

Addison, N. Y.—The building with its contents containing the electric light and water company's machinery was lately destroyed by fire, entailing a l)ss of $70,000.

Brewton, Ala.—The city electric light and waterworks plant was damaged considerably by a recent fire.

Carrollton, Ga.—An election is to be held June 4 to vote on the matter of issuing bonds to the amount of $45,000, for waterworks, sewerage and electric light purposes.

Cape May Point, N. J.—The streets of this place will be lighted with electricity during the summer.

Carthage, Ill.—The Carthage Electric Light & Power Company has increased its capital stock from $20,000 to $50,000, and changed its name to the Carthage Electric Light & Heating Company. The plant will be enlarged.

Conroe, Tex.—W. H. Clark, merchant, is arranging to put in a small electric light plant to supply lights for the business section of this city.

Cookeville, Tenn.—It is now thought to be almost an assured fact that the Gainsboro Telephone Company will in the near future erect an electric light plant in this city.

Deland, Ill.—The council is figuring on putting in an electric light plant at a cost of $6,100.

Duquoin, Ill.—An,electric light plant is under consideration. Job Cook, city clerk, Box 88, may be addressed.

Freeburg, Ill.—The amount of $5,000 has been voted for an electric light plant. John Sintzeley, clerk.

Janesville, Minn.—This town will soon offer bonds for sale for an electric light plant.

Joplin, Mo.—On June 6 the citizens will vote on the issuance of $30,000 bonds to improve the city lighting plant.

Kilbourn, Wis.—The village board is considering the question of lighting the village by electricity.

Middletown, Ill.—There is a rumor that electric lights are to be established here.

Montague, Mich.—This town is reported to be considering plans for an electric light plant.

Norwich, N. Y.—S. N. Blake, of the Norwich Gas & Electric Company, promises improvements in street lighting.

Oyster Bay, N. Y.—The Oyster Bay Electric Light & Power Company is preparing to equip its plant with more power to meet the requirements of its business. It has also adopted a new shunt lamp, which will remove the danger of the light being extinguished from any ordinary cause.

San Francisco, Cal.—A meeting of the stockholders of the Mutual Electric Light Company has been called for June 21 to vote on an issue of $400,000 5 per cent. gold bonds, of which $250,000 will be for immediate improvements.

Schoolcraft, Mich.—The power house of the electric lighting plant here was lately destroyed by fire.

West Point, Ia.—The electric light proposition is being agitated here.

Williamstown, N. J.—The township committee has advertised for bids for lighting this town with electricity.

STREET RAILWAYS.

Bessemer, Ala.—The proposed line of the Brookwood Electric Company will be constructed and equipped for $260,000.

Columbus, O.—Superintendent Ralph Peters, of the Pennsylvania lines, has confirmed a report that the Cincinnati & Muskingum Road is planning to equip the line from Trinway to Lancaster with electric power, so as to compete with interurban lines that are contemplated.

Decorah, Ia.—It is stated on the authority of men who are financially interested in the project that the proposed electric line between here and Chatfield, via Preston, is now a certainty, and that the work has partly been laid out for a considerable distance from this city, and the full right of way to Chatfield has been secured.

Emporia, Kan.—Hugh Holmes, of Kansas City, who is building an electric railroad from Kansas City into Central Kansas, is interesting local business men in building a line from Ottawa to this city.

Evansville, Ind.—William L. Sonntag has organized a company here to build an electric line from this city to Rockport.

Glasgow, Mo.—Col. W. H. Chase is the promoter of the Missouri Central Electric Railway here.

Kalamazoo, Mich.—The common council has granted a franchise for an interurban electric line, which it is proposed to build between here and Benton Harbor. This will, if built, be the only road through the peach and grape belt.

Lansing, Mich.—The West Michigan Interurban Railway Company, with a capital stock of $1,000,000, has filed articles of incorporation with the Secretary of State. The organization is effected to build a trolley road from Grand Rapids via Muskegon to Park, Oceana County. F. A. Nims, of Muskegon, and ex-Senator J. K. Flood, of Hart, are among the incorporators.

New Decatur, Ala.--Parties from the Decaturs, Florence, and elsewhere, are contemplating the building of an electric street railroad from this city to Moulton, in Lawrence County, a distance of about 20 miles.

New York City.—The electrical equipment of the New York City terminals and the suburban lines of the New York Central is expected to be pushed actively, now that funds have been provided by the recent negotiations of the company's $30,000,000 debenture bond issue. In discussing the improvement plans lately W. J. Wilgus, fifth vice-president and chief engineer of the New York Central, said that electricity would be used not only in the tunnel, but also to White Plains, on the Harlem, and to Ossining or Croton Landing on the New York Central.

Olean, N. Y.—There is talk of an electric road running from Addison to this place via Woodhull, Rexville, Whitesville and Wellsville, thence to Bolivar, connecting with the line of that village to Olean.

Trinidad, Col.—It is understood that the Trinidad Electric Railway Company contemplates very shortly extending its line from this city to Aguilar 26 miles north. P. M. Johnston is one of the promoters.

Wallingford, Conn.—The new electric road of the Wallingford Tramway Company will soon be built.

West Point, Va.—The New Point Comfort Company has been canvassing some of the lower Tidewater counties soliciting subscriptions for an electric line. If the counties to be benefited by the company take $25,000 of the company's stock it is asserted that an electric railway from New Point Comfort to this place will be completed this year. Mathews and Gloucester County are expected to subscribe this amount.

POWER PLANTS.

Baker City, Ore.—The Oregon Power & Development Company has been incorporated with a capital of $200,000. An electric plant will be constructed in the Greenhorn mining district on Granite Creek. Water power will be obtained from Granite, Boulder and Sunrise Creeks.

Duffryn Mawr, Pa.—The Ridley Creek Electrical Supply Company has purchased the John G. Smedley farm, in Willistown Township, Chester County. There is a fine water power on this property of sufficient energy to produce abundant electricity. The company proposes to furnish light and power to this place, Paoli, Malvern and other adjacent points along the Pennsylvania Railroad.

Eureka, Cal.—The Eureka Lighting Company will erect a power plant about four miles below Hyampom. Surveys will be started soon.

Granville, N. Y.—The Granville Gas, Electric Light & Fuel Company, composed mostly of Sandy Hill capitalists, is about to begin the erection of a dam at Lake St. Catherine, near here. About 2,000 hp. will be developed. Surveyors are now on the preliminary work, and as soon as the work of constructing the dam is under headway the building of a line to Whitehall and furnishing electricity for light and power will be begun.

La Grande, Ore.—J. K. Roming, manager of the Sanger mines here, states that a large power plant is to be installed at the mines soon.

Lowell, Kan.—W. O. G. Sergeant is preparing to begin construction on a mammoth power plant at this place, 16 miles west of Joplin.

Quincy, Cal.—The Quincy Water & Power Company has been incorporated by J. D. Goodwin and others with a capital stock of $50,000. The waterworks will be improved and an electric power plant installed.

San Francisco, Cal.—The park commissioners are considering a plan to install an electric power plant in Golden Gate Park. The new equipment would cost $7,200.

BIDS WANTED.

Vancouver, Wash.—Sealed proposals in triplicate will be received until June 9 by F. G. Hodgson, quartermaster, for constructing an electric lighting system at the Vancouver barracks.

Woodville, Miss.—Sealed bids will be received by the mayor and board of aldermen of this place until June 7 for the erection of a system of waterworks and electric light plant. D. C. Bramlette, treasurer; C. N. Jenks, engineer, Fayette, Miss.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 13@13⅛c.; Lake 13⅛@13¼c.; casting, 12⅞@13c.

The Illinois Traction Company, capital $4,000,000, has been incorporated at Augusta, Me.

It is reported that the Chicago Telephone Company will issue $1,000,000 new stock within a few weeks.

The Philadelphia Electric Company has declared the regular semi-annual dividend of 18¾ cents a share, payable June 15.

The Bell Telephone Company of Missouri has been given authority to increase its capital from $4,000,000 to $10,000,000.

A special meeting of the stockholders of the Tampa (Fla.) Electric Company has been called for May 30, to increase the capital stock by the amount of $100,000.

The New England Telephone & Telegraph Company will in all probability issue additional stock this summer for new construction.

Official notice has been received by the New York Stock Exchange from the General Electric Company of the increase of its capital stock from $45,000,000 to $48,325,000.

The United Traction Company of Albany, N. Y., has given to the Central Trust Company of New York a mortgage of $6,500,000 to cover an issue of 6,500 gold bonds of $1,000 each.

Phelps-Dodge people say that under general business conditions 13 cents is a fair price for copper and they are willing to fill orders at this price. They rather look for prices to hold around a 13-cent level.

It is estimated when the full plans of the Public Service Corporation are carried to completion this company will own or control practically all the street railway and gas companies of any importance in New Jersey.

The Massachusetts Electric Companies now has $20,557,400 of preferred and $14,293,100 of common stock outstanding, back of which are 165,000 shares of underlying stocks, or a ratio of 1¼ to 1 in preferred and ¾ to 1 in common stock.

The board of directors of the United Railways & Electric Company of Baltimore, at a meeting Thursday, will decide upon what action will be taken in regard to the payment of the June coupon on the income bonds.

By the payment recently of the final installment on its new stock, the Boston Edison Company has taken up about $500,000 of its notes leaving at present $1,000,000 still outstanding. These notes are of various maturities, the longest being for a year, and the latter bearing a 4 per cent. interest rate.

It is again rumored that payment of dividends on New York Interborough stock may begin this summer, the surplus earnings of the elevated lines after providing for the full 7 per cent. dividend on Manhattan stock being sufficient to warrant the lessee company in making a distribution to its own stockholders.

President C. S. Mellen has announced that formal merger will be made this week of the Meriden (Conn.) Electric Railway Company and the Consolidated Railway Company, both of which are controlled by the New York, New Haven & Hartford Railroad Company. Friday the merger of the Winchester Avenue Railroad Company and the Fair Haven & Westville Railroad Company, comprising the traction service of New Haven, and the Consolidated Railway Company, was officially made.

ELEOTRIOAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price May 21
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	143½
Metropolitan Street Railway	111
Metropolitan Securities	77⅜
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	40⅜
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	65¼
Philadelphia Traction	95¾
Union Traction, $17.50 paid	49¾
Boston.	
Boston Elevated, full paid	141
West End Street, com	90
do. do. do. pref	111
Chicago.	
City Railway	158
North Chicago	71
Union Traction, com	5½
do. do. pref	28
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	27
do. do. pref	60
Electric Lead Reduction	⅝
Electric Vehicle, com	6¼
do. do. pref	9½
Westinghouse, com	156
do. pref	194
General Electric	155
Boston.	
Edison Electric Illuminating	234¼
General Electric	155
Massachusetts Electric Companies, com	17¾
do. do. do. pref	70
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	145
National Carbon, com	29½
do. do. pref	102½
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	57½
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	124½
Western Telephone Company	8⅜
New England Telephone Company	121¾
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	87¼
Miscellaneous.	
Chicago Telephone Company	116
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

The Boston Convention.

The Twenty-seventh Convention of the National Electric Light Association, which was held last week in Boston was eminently successful and satisfactory. In spite of the fact that the "Hub" can hardly be termed a hub so far as the electric lighting industry is concerned, and though it might more aptly be likened to a point half way up the spoke, there was no lack of delegates, over four hundred being present from all parts of the country.

The papers dealt with subjects of vital interest to the industry, and what is more were very thoroughly discussed, which has not always been the case in the past.

The social features were as usual everything that could be desired, and though the weather was fine it was warm.

The proceedings as well as several of the papers presented will be found elsewhere in this issue.

* * *

Coast Government Control.

Advices from San Francisco state that for the first time on the Pacific coast communication has been had by wireless telegraphy between a ship at sea and points on shore. The United States hospital ship Solace sailed from the above port recently and until she was 70 miles out messages were sent between the Solace and the Weather Bureau's stations at Point Reyes, on the mainland, and on the Farallone Islands, which lie off that city. Conditions were very favorable, and communication was continued without a break for five hours.

The local Weather Bureau has been informed by Willis L. Moore, chief of the service, that all the California observation stations and those on Tatoosh Island and North Head, in Washington, will soon be equipped with the latest instruments.

In connection with wireless telegraphy stations along the coast it is interesting to note that steps are about to be taken to place them all under Government control. This decision has been reached by a committee of Cabinet members to whom the question was referred. If it is carried out it will seriously interfere with Marconi and his Cape Cod station, from which point he proposed to establish communication with England. The Marconi station on Nantucket lightship has already been ordered discontinued, and the Navy Department has established a modification of the Slaby-Arco system, which is in use on German ships. The Navy Department has established with considerable secrecy seven stations along the north Atlantic coast. The Government proposes to handle free messages to or from persons on ships at sea, turning such messages over to the telegraph companies to be forwarded to destination.

In the opinion of many it will be impossible to make wireless telegraphy valuable for commercial purposes, or in time of war, unless its control is vested in the general Government.

* * *

Alternating Current Measuring Instruments.

Mr. W. Duddell, whose oscillograph is now so well known, described some new instruments, for the measurement of large and small alternating currents, before a recent meeting of the Physical Society in London. They were three thermal instruments of his own construction. One was essentially a sensitive Ayrton-Perry twisted strip ammeter, which is very quick in action for a thermal instrument, and has been used for observing and recording potential differences and currents which varied as

rapidly as one per second. It is compensated for change in the surrounding temperature by forming the sides of the frame which holds the twisted strip with the same wire that the strip itself is made from.

Mr. Duddell exhibited an instrument in which a current of 22 milliamperes gave a deflection of one-quarter the scale-distance, i.e., 250 ohms at one meter scale-distance. The mechanical periodic time is only about one-fifteenth second. Using this instrument in series with a high resistance Mr. Duddell has made observations on the variations in the voltages of alternators caused by cyclic irregularity of the engine. By working to a false zero it is easy to obtain 10 mm. change in deflection for one per cent. change in the potential difference.

The second instrument exhibited was a very sensitive thermal galvanometer called a "thermogalvanometer." It is a combination of a radio-micrometer of the "Boys" type with a very small resistance which is heated by the current to be measured, and which in turn heats the thermo-junction of the radio-micrometer by radiation and convection. The principle of its action may be described thus: A loop of wire has its two ends fixed to the two bars of a single thermo-junction, a mirror is fixed to the loop, and the whole is suspended in a magnetic field by means of a quartz fiber. The heat from the resistance raises the temperature of the thermo-junction and causes a current to flow round the loop which is deflected by the magnetic field. The sensibility of the instrument depends on the resistance of the heater. Using a heater having a resistance of 13,910 ohms, a deflection of 250 mm. at a scale distance of one meter is obtained with a current of 31 micro-amperes; a heater having 18 ohms resistance required 800 micro-amperes to give the same deflection. Mr. Duddell, in order to illustrate the high sensibility of this instrument showed the large deflections produced by the currents through a telephone receiver even when the source of sound was many feet distant from the microphone. He also showed that if the thermogalvanometer was placed in series with the vertical receiving wire in spark telegraphy over a short distance, large deflections were produced.

The third instrument was a switchboard instrument which works on the same principle as the last, only the moving part is pivoted in the usual way. One of the instruments, which was exhibited to the Physical Society audience, was arranged to give the whole scale deflection for only 0.15 volt; this can be used in connection with shunts to measure large currents; for instance, to measure 1,000 amperes the power lost in the shunt would only be 150 watts. Transformers can also be used as the power to produce the whole scale deflection is only 0.3 watt. The author also placed on view a similar instrument with a high resistance heater; it gave the whole scale-deflection for 0.1 ampere, and can be used as a voltmeter by putting resistance in series with it.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Among the examinations of the United States Civil Service Commission, to be held at Albany, N. Y., June 22-23, are electrical and civil engineering, at salaries from $1,200 to $1,400 per annum in the Philippine service.

A dispatch from Berlin announces the death of Wilhelm von Siemens, of the Siemens & Halske Company. He was a member of the famous Siemens family, whose inventions have been foremost in the modern industry of electrical engineering. He was frequently consulted by the Emperor William, especially in connection with the electric line at Zossen.

It is reported from Boston that Boston and Worcester street railway interests are considering plans for the building of a double track, high speed electric line from Boston to Providence, to enter into active competition with the New York, New Haven & Hartford Railroad Company. The cost is estimated at $2,500,000.

Dr. M. I. Pupin, of Columbia University, lectured before the New York Electrical Society, in Havemeyer Hall, on May 25, on a method which he has perfected for sending telegraph messages. Dr. Pupin said that his invention would admit the sending of six messages simultaneously over a single line, to a greater distance, and more rapidly than is possible at present. He also said that a lighter wire than is now common could be used. Dr. Pupin exhibited a model of his invention and explained its workings in detail. This model is to be sent to the pavilion of the United States Patent Office at the St. Louis Exposition.

A fireproof insulation for electric wires, which, it is believed, will remove one of the most frequent causes of fires in buildings in which electricity is used, was described recently by Dr. William H. Easton, of York, Pa., at a meeting of the Franklin Institute. The new insulation, which has recently been perfected after years of experiment, consists of a covering of asbestos chemically united by the action of heat, with a cement, producing a hard, flexible waterproof and fireproof sheathing over the wire.

Members of the New York Rapid Transit Commission are looking with decided favor on the proposition made by the Schmidt & Gallatin Syndicate, in connection with the Belmont interests of the the Interborough Rapid Transit Company, to install a system of moving platform subways in the crosstown streets so as to provide an interchangeable transfer system between these subways and the Interborough subways and elevated lines.

A telegraph instrument has been invented that is attracting the attention of railroad telegraphers. It is called a mecograph and is a small simple contrivance about the size of an ordinary relay. It is composed of a baseboard, a standard from which is suspended a pendulum, a key, two binding posts for a split cord, on the end of which is a wedge that fits in the Morse key, and one or two other essentials. From the bottom of the pendulum, which forms one pole of the wire, extends a flat spring carrying a platinum point which, when set in motion, vibrates between two points or bumpers, one of which forms the opposite pole. The advantage the inventor claims for the instrument is that it reduces the work of the operator. In making a six dot figure but one movement is necessary.

United States Commercial Agent Harris at Eibenstock has made a report to the State Department of the industrial schools in Saxony, which have been founded for the sole purpose of training young men to become competent and skillful locksmiths and blacksmiths. These schools are located in the following cities: Burgstadt, Grossenhain, Frankenberg, Meissen, Glauchau, Rosswein and Zittau. The report contains an interesting account of the course of studies in these schools, and shows an extra cost for advanced training in electrical science. Special attention is called to the number of hours devoted to practical instruction in the workshop. There the students are drilled in the art of constructing and laying telephones, telegraphs and lightning rods, as well as of drawing and constructing machinery of every description for the application of electricity and steam.

PROCEEDINGS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION AT BOSTON

President Charles L. Edgar called the 27th Convention of the National Electric Light Association to order at 10:45 A. M. on Tuesday, May 24, at the Hotel Vendome, Boston, and said: "I take great pleasure in calling the 27th Annual Convention of the National Electric Light Association to order. The first business will be the reading of acceptances of invitations to attend this meeting and letters of regret at not being able to do so, from various gentlemen, both past presidents, honorary members and distinguished gentlemen whom we have invited to attend.

Several letters were read by Secretary Davis, among them one signed by Thomas A. Edison, saying that he would like to be in attendance but at present was "having so much trouble" with his stomach that it seemed "uncertain." Then President Edgar read his address, saying:

THE PRESIDENT'S ADDRESS.

"It is now 17 years since this association met in Boston, and I cannot resist the opportunity to make a few comparisons between the year 1887 when this association met at the Parker House, and the present year. It was my pleasure to attend that convention as a guest of our old friend, Captain Brophy, and I have a somewhat distinct recollection of the meetings and of the entertainments. I know it was with considerable anticipation that I looked forward to the visit to the works of the Thomson-Houston Company in Lynn, then rated as one of the largest works of its kind in this country, and yet the number of men employed in the entire works at that time was not as many as it now employs in almost each one of the dozen departments.

"At that time, too, the Boston Edison Company, who, with friends and associates in Boston, is one of those to welcome you here to-day, was the proud possessor of one small station, with total load connected to its overhead system equal to the fortnightly growth of the present year. In those days, too, the horse cars made their weary way along the Tremont street mall of Boston Common. To-day not only horses, but cars and tracks have disappeared, and under this same mall is located one of the finest electrically operated subways in the world.

"We are astounded when we turn our gaze upon our own business as represented by the members of this association distributed throughout the United States and Canada. The number of electric light stations has increased during these 17 years more than ninefold. Naturally the membership of this association has not grown in proportion, but the fact that there are now on our rolls 588 members as compared with only 158 at that time, is a matter for sincere congratulation."

Mr. Edgar called attention to the need of a change in the association by-laws. When the body was organized, 19 years ago, there was a large number of small companies. Consolidations have wiped out the small companies or absorbed them, and their membership in the National Association has disappeared. In the Boston district the membership has thus been cut down from seven to one. The President suggested a new class of memberships to make up for those thrown out by the absorption of their companies,

ERNEST H. DAVIS,
President-elect of the National Electric Light Association.

this class to consist of "junior active members," to be elected under some sort of supervision from the active members, with whom they are connected in business, and paying dues, an amount in keeping with their privileges.

The President noted the lack of a comprehensive and correct directory of the electric lighting industry, and announced that this lack was about to be remedied by the action of one of the association members. An index of the association records has also been undertaken.

One novel paragraph in President Edgar's address was the one calling attention to the new use of the service of electric companies last winter in thawing water pipes, and he suggested the appointment of a reporter to look into the subject, to collect and distribute to members the experiences of the various companies in this respect.

President Edgar recommended a strong, permanent committee to deal with the subject of municipal ownership of electric lighting plants.

Mr. Henry L. Doherty—Mr. President, it has been customary to refer the address of the President to a committee to report upon the recommendations contained therein. The address you have just heard probably contains as many, if not more, valuable suggestions for the future conduct of the association than any of the addresses we have heretofore heard. It is a comprehensive effort to put the affairs of the association in better shape, and I move, Mr. President, that the Secretary be instructed to appoint a committee of three to consider and report upon the recommendations in the President's address.

The Secretary put the motion, which was carried, and the Secretary appointed as such committee Henry L. Doherty; George W. Brine and H. T. Hartman.

President Edgar—I desire to announce that the sessions of the convention will be called to order strictly on time, and the chair hopes that the members will be punctual in their attendance, so that we may proceed with the business in a proper manner and have sufficient time to consider all the papers. The first paper on the programme is one on a subject which was new last year, but which was such a success that it is repeated this year, and I have no doubt that will be repeated indefinitely at our future meetings. I take pleasure in introducing Mr. T. Commerford Martin, of New York, who will present a report on "Progress."

Mr. Martin—Mr. President, I understand from the remarks which have been made, regarding the papers being in type and sent to the members of the association a week ago, that it will hardly be necessary to read the papers in full. Mine was one of the papers in type. The members have, therefore, had a full week in which to determine the value of its contents, and I hardly think it necessary for me to take up your time in presenting merely an abstract of the paper.

Mr. Martin called attention to the run of the contents of the report. (An installment of the report will be found on another page of this issue of ELECTRICITY.)

The President—We will now proceed to the next paper, "A Three-Wire, 500-Volt Lighting System," by Mr. Walter I. Barnes, Providence, R. I.—Mr. Barnes read the paper and it was discussed by

Messrs. Woodward, Whitfield, Junkersfeld, Ferguson, Dow, Williams, Doherty, Gossler and Hallberg. Capt. William Brophy brought out many important points in the discussion.

The President—We will close the discussion on this paper and take up the paper on "The Luminous or Flaming Arc," by Mr. Welles E. Holmes of Newton, Mass.

Mr. Holmes read the paper, which was discussed by several members.

The President—I have on this morning's programme the reports of four committees, all of whom are going to ask to be discharged, and I think possibly it would be well to adjourn this business until the beginning of the afternoon session. It won't take over five minutes to discharge the four committees, as they request.

On motion adjourned until 2:30 P.M.

AFTERNOON SESSION.

President Edgar called the meeting to order at 2:30 o'clock promptly.

The President—We will now take up the consideration of the reports of the four committees which were left over rom the morning session. We will first consider the committee Report on Uniform Accounting, of which Mr. Guy L. Tripp, of Boston, is chairman. Mr. Tripp wrote me a letter, saying that he regretted he could not be present at this meeting and said he had nothing further to report as chairman of the committee.

The President—The Committee on Legislative Policy is another of these committees. Mr. Samuel Insull, of Chicago, the chairman of this committee, is abroad. The committee has done no work for several years.

Mr. W. M. Anthony, Chicago—I move that the committee be discharged. Motion carried.

The President—The Committee on Standard Candle Power of Incandescent Lamps, Dr. Louis Bell, chairman, and the Committee on Photometric Values of Arc Lamps, Mr. Henry L. Doherty, chairman, are the two remaining committees to be considered, but as the chairmen of these committees are not in the meeting room, although present at the convention, we will pass those for the present. We will now take up the paper, "A One Hundred Mile Transmission Line," by Mr. Robert Howes, Spokane, Wash.

Mr. Howes read the paper and at its conclusion added: "Since I wrote this paper we have received the regulator and gotten it installed in time for me to know the results before I left Spokane. We succeeded in holding our voltage at Spokane practically steady. There was a variation not to exceed ¾ of a volt above or below the normal on a 116-volt basis. At the other end of the line this cut down the variation to a trifle over one-half of what we had before. Then the controller for the motor arrived, but without a time relay device. When that was installed we cut down the variation at the other end to one-half of what it was then, leaving us with a variation of ¼ at the other end of the line to what it was when we wrote this paper. We now have variations of 5 to 6 per cent. on either end of the line in extreme cases."

The President—The paper on "Grounding the Neutral of High Voltage Generators," by Mr. George N. Eastman, of Chicago, will now be considered.

Mr. Eastman presented the paper and a short discussion followed.

The President—The next paper is on the "Remote Control of Electrical Apparatus," by Mr. William H. Cole, of Newton, Mass.

Mr. Cole presented the paper.

The President—We will proceed to the next paper, "The Organization and Equipment of an Arc-Lamp Department," by Mr. Samuel G. Rhodes, New York.

Mr. Rhodes read the paper.

The President—I want to say one thing in regard to Mr. Rhodes' paper. Of all the papers asked for in advance by members to whom I sent a list of the papers, this paper was asked for by more delegates than any other paper before the convention. Mr. Rhodes' paper seems to be such a complete story of the whole subject, that I judge, from the absence of any gentlemen arising to discuss it, that there seems to be no member who wants to know more about it. It seems a shame to pass such a paper without a very thorough discussion.

The President—We will take up the next business, which is the report on "Lost and Unaccounted for Current," by Mr. C. W. Humphrey, Denver, Col.

Mr. Humphrey presented the report, and after a short discussion the meeting adjourned until 10 o'clock on Wednesday morning.

Wednesday, May 25.

MORNING SESSION.

President Edgar called the meeting to order at 10 o'clock promptly and announced the first paper on the programme to be that on "Economy in Minor Station Supplies," by Mr. Edgar B. Greene, of Altoona, Pa.

Mr. Greene read the paper.

The President—The next paper in order is that on "Notes on the Internal-Combustion Engine as Applied to Central Station Service," by Mr. E. E. Arnold, of Pittsburg. Pa.

Mr. Arnold presented the paper.

The President—We have three or four papers on kindred subjects this morning, and with your permission I am going to ask the gentlemen who are to take part in the discussion of these papers to wait until the papers have all been read and then we will have a general discussion of all of them at the same time. Pursuing that policy, we will have the paper on "Economy Test of a 5,500 Horse-power, Three-Cylinder, Compound Engine and Generator," by Messrs. J. D. Andrew and W. F. Wells, New York.

Mr. Andrew read the paper.

The President—Gentlemen, with your permission I am going to change the order of programme just a trifle and pass the paper on "Mechanical Stokers" for the next half hour, and take up the paper or report of the Committee on Investigation of Steam Turbines, Mr. W. C. L. Eglin, of Philadelphia being the chairman of the committee.

Mr. Eglin presented the report of the committee.

The President—I have asked both the General Electric Company and the Westinghouse Electric & Manufacturing Company to either prepare papers on this subject of steam turbines, or to discuss them. Mr. Rice is here prepared to discuss the subject, and Mr. Hodgkinson has prepared a paper on it.

Mr. Louis A. Ferguson—Mr. President and gentlemen, I know that Mr. Eglin and his associates have spent a great deal of time during the year in preparing this report, and I therefore move that a vote of thanks be given Mr. Eglin and his associates for this excellent report which they have presented.

Mr. Ferguson's motion was put and carried.

The President—We will now take up the paper on "Practical Notes on Steam Turbines," by Mr. Francis Hodgkinson, of Pittsburg, Pa.

Mr. Hodgkinson read the paper.

DOHERTY MEDAL AWARDED.

A pleasing feature was the award of the Doherty gold medal for the best paper on "Underground Electrical Construction. The winner was W. P. Hancock, at present general operating superintendent for the Boston Edison Company. Dr. Schuyler S. Wheeler, of Ampere, N. J., who, with Past President L. A. Ferguson, and H. G. Stott, of New York, composed the committee of judges, in announcing Mr. Hancock's success, said that a paper by John D. Blood had been very highly commended and was so well

put together as to be remarkable in that respect, but Mr. Hancock's paper showed such mastery of detail and covered the whole subject so completely that the members of the committee, though acting independently, had each concluded that Mr. Hancock deserved the prize. Past President Doherty said he had been constrained to offer the medal by the need of standard practice in underground construction and he hoped the competition had done something to stimulate such uniformity.

The President—We will now have the paper on "The Mechanical Stoker and the Human Operator," by Mr. Edwin Yawger, Pittsburg, Pa.

Mr. Yawger read the paper, which will be found in this issue of ELECTRICITY.

On motion the meeting adjourned until 10 o'clock on Thursday morning.

Thursday, May 26

MORNING SESSION.

President Edgar called the convention to order at 10:30.

The first paper was on "Electric Light and Power Plants in Connection with Ice Plants." The author, Mr. C. L. Wakefield of Dallas, Tex., was not present and the paper was read by Mr. Maunsell. In the discussion points were brought out to show the value of the installation of refrigerating plants operated by electricity.

The committee on nominations was appointed as follows: P. G. Gossler, D. P. Robinson, Irvin Butterworth, W. C. L. Eglin and F. E. Smith.

The report of the committee on the President's address was presented by Mr. H. L. Doherty, chairman. The convention approved the recommendations of the President.

The report of the Committee on Purchased Electric Power in Factories was read by Mr. W. H. Atkins, chairman, and was discussed by Louis A. Ferguson, Arthur Williams, P. G. Gossler, Charles B. Burleigh and J. F. Dumesmay.

The report of the committee on Purchase Electric Power in Factories called out a protracted and interesting discussion after which the convention adjourned until 2:30 P.M.

AFTERNOON SESSION.

The report of the committee on District Heating was the first business taken up in the afternoon session. This report was presented by Mr. E. F. McCabe of Lewiston, Pa. The report on Office Methods and Accounting was presented by Mr. Frank W. Frueauff, of Denver. A paper on "A Proposed System of Standard Instruments for Operating Companies," by Mr. H. P. Davis, of Pittsburg, was read. This was followed by the paper on "Single-Phase Power Motors for Electric Lighting Stations," by W. A. Layman, of St. Louis.

At the executive session held on Thursday evening, the reports of the Executive Committee, Secretary and Treasurer, and the Committee on Finance were presented.

The Treasurer's report showed the following transactions during the year:

Balance, 1903	$ 8,651.90
Receipts	11,214.00
Total	$19,865.90
Expenses	10,392.17
Balance, 1904	$9,473.73

Mr. William Brophy presented the report of the Committee on Standard Rules for Electrical Construction and Operation.

THE NEW OFFICERS.

The Nominating Committee presented the following nominations: President, E. H. Davis, Williamsport, Pa.; First Vice-President, W. H. Blood, Jr., Seattle, Second Vice-President, Arthur Williams, New York; Secretary and Treasurer, Dudley Farrand, Newark; Executive Committee, Samuel Scovil, Cleveland; H. A. De Camp, Philadelphia; W. F. White, St. Louis.

On motion, a vote of thanks was passed to the New England Electrical interests for the very elaborate entertainment and many courtesies received by the delegates.

A vote of thanks was passed to President Edgar for the efficient manner in which he has presided over the convention, and for the very great amount of work he had performed in the interests of the asssociation during the term of his Presidency.

President E. H. Davis was escorted to the chair by Messrs. Doherty and Ferguson and upon his installation assured the convention that all his efforts would be entirely devoted to the success and best interests of the association.

Ex-President Edgar acknowledged the courtesy of the members to him during his administration, and the meeting adjourned.

Obituary.

It will be learned with regret that Thomas Rowland Western, cashier of the Manufacturers' Advertising Bureau, New York, of which Benjamin R. Western, his father, is the proprietor, died suddenly on Sunday, May 22, after an illness of only a few days. Mr. Western was of a genial and accommodating disposition, and will be missed by many admiring friends.

REPORT OF THE COMMITTEE ON PROGRESS.*

BY T. COMMERFORD MARTIN.

The central station industry of the United States has enjoyed since this association last met, in Chicago, another year of marked advance and prosperity. Although the period has been one of uncertainty and disturbance in the financial markets, the disasters of speculation thus thwarting the legitimate hopes and ambitions of industrial enterprise and checking new investment, electric lighting has experienced no setback. The rate of gain over previous periods has apparently been maintained, if indeed it has not been accelerated.

Statistical data are the first that should receive consideration, and fortunately we now have a firm basis upon which we can found our study and analysis of the figures of electric light and power. When I had the honor to present my report last year as Committee on Progress, the United States Census statistics were not available as to the growth and status of the art. They have since been published, and are perhaps now familiar. As special expert for the Government in connection with this work, and having an opportunity, therefore, to test the work done, I can speak with praise in regard to the conscientious, intelligent and painstaking manner in which Messrs. S. N. D. North (now director of the Census Office) and W. M. Steuart (now chief statistician for the Department of Manufactures in the Census Office) sought to verify and confirm every statement given out.

FIGURES OF THE INDUSTRY.

It is to be borne in mind that the figures quoted are for 1902, but they are the latest available and now for the first time become part of the association's record. These being the first compiled it is difficult to establish a percentage of annual gain, but it is safe to say that the rate of increase each year is not less than 10 per cent. A great many companies do better than that. At the time of the enumeration there were 3,620 central electric stations in operation. The cost of their construction and equipment amounted to $504,740,352. The gross income for the year was reported at $85,700,605, and the total expenses at $68,081,375. These stations furnished employment to 23,330 wage-earners, who received $14,983,112 as wages during the year. The power-plant equipment consisted of 5,930 steam engines with 1,379,941 indicated horse power, and 1,390 water wheels with a

*Abstract of report read before the National Electric Light Association at its 27th Convention, held at Boston, Mass., May 24-27, 1904.

stated horse power of 438,472. The generating plant consisted of 12,484 dynamos of every description with a stated horse power of 1,624,980. A noteworthy feature in the development of this industry has been the installation of plants operated under the control of municipalities. There were 815 of these plants in operation. The cost of their construction and equipment was reported at $22,020,-473. They gave employment to 2,467 wage-earners and paid $1,422,341 in wages.

The above figures, however, do not tell the full central station story, as during the same year there were 252 electric railways doing a central station business; nor, of course, are any data presented from the 50,000 isolated plants—more or less—that exist all over the country. The current output for the year was estimated and returned at 2,507,051,115 kw. hours, or about 25 per cent. of the possible work that the stations could do in 24 hours of daily operation. There were 385,698 arc lamps operated and 18,194,044 incandescents. There were reported 99,102 stationary power motors on the circuits, with a capacity of 619,283 horse power, and 2,379 trolley cars were supplied with current. Of the street railway companies in the lighting field, as shown by the Census report on the street railways, 118 made reports that were kept separate, although 252 such companies generated current for light and power, with a total income from it of $7,703,574. They had 33,863 arcs, 1,442,685 incandescents and 10,049 motors of 35,688 horse power.

It is interesting to note that all the street railways of the country had just about 1,300,000 horse power in engine and water wheel capacity. The lighting plants had just about 1,750,000 horse power. The output for the street railways was returned at 2,261,484,397 kw.-hours for the year, or 6,249,910 per day; so that while the output of the lighting plants was a quarter million kilowatts larger daily, the plants ran fewer hours. This is quite in accordance with observation. The dynamo capacity of the street railways was 1,204,238 horse power, while the dynamo capacity of the lighting plants was 1,615,-480 horse power. Reducing this to kilowatts, it would appear that the capacity of the railways was in full use nearly eight hours daily, while the capacity of the lighting plants was in use about six hours daily. The railway figures are a little later than those of the lighting plants, but they all overlap sufficiently to permit this interesting comparison.

CONDITIONS ABROAD.

Last year I gave some figures from various countries abroad as a gauge of our own progress, aside from their direct interest. I trust the time will soon come when, either through the work of governmental census bureaus or of kindred bodies, this association may be able to undertake the valuable task of comparing the electric light statistics of the whole world. Such figures would be at once instructive and stimulating, and not altogether so flattering to our national pride as a superficial examination might indicate.

Perhaps England should receive our first attention, and the figures there are presented in the recent inaugural address of President R. K. Gray, of the British Institution of Electrical Engineers. He pointed out that two-thirds of all the electric lighting in the United Kingdom is in municipal plants and only one-third in the plants of private companies. In fact, if London, the main home of the companies, be excluded from consideration, nearly seven-eights ot the lighting is in the hands of municipalities. In the United States only about 5 per cent. of the lighting is municipal. The average rated capacity of a British station is about 1,400 kilowatts, while that of the United States is only 340 kilowatts. The total rated station capacity in Great Britain is, however, given only as 480,000 kilowatts, while in the United States the total in June, 1902, was 1,200,000 kw. for less than 4,000 plants as compared with less than 400 British. Consequently while the average British station is four times as large as a United States station, the United States lighting is nearly three times as large as the British. A noticeable feature mentioned in the address is that while candle powers of lamps are less in Britain than with us, so that the standard is the 8-cp. lamp, yet the distributing pressures are generally higher, and 200-volt lamps are much more common. In this country the large stations, which began operations upon 110-volt lamps with the three-wire system, have not generally judged it to their advantage to change to 220-volt pressures. Nernst lamps are spoken of as a factor in British electric lighting, and also osmium lamps, which latter are still curiosities in this country. They are described as having, in 25 and 30-volt pressures, an efficiency of two-thirds candle per watt and as showing but little diminution in light or efficiency after 800 or 1,000 hours of burning. Motors are gaining ground in England, and, exclusive of power or transmitting companies, the public supply stations had motors of an aggregate capacity of 55,000 horse-power connected to their mains.

As to Germany, the latest authentic statistics are about a year old, but this is a normal interval. In April, 1903, no fewer than 971 stations were reported. There were 50 plants that had a capacity above 2,000 kilowatts. The highest capacity, namely, 26,523 kilowatts, was that of the Moabit station of Berlin. The total capacity of these 50 stations, situated in 37 cities, was 271,479 kilowatts. The total number of plants reporting was 939 (against 870 in 1902). to which there were connected 5,050,584 (against 4,200,-203 in 1902) incandescent lamps of 50 watts, 93,515 (against 84,891 in 1902) arc lamps of 10 amperes, and motors of an aggregate capacity of 218,953 horse power (against 192,059 horse power in 1902). There were a number of stations that supplied current, not to a single town but to a number of towns. For instance, the Bruehl station supplied 66 towns, at a distance of 9 to 12 miles, with current for light and power. The whole industrial district of upper Silesia was supplied from a single plant, while the water power plant at the Rhine Falls supplied 46 towns. In the industrial districts near the Rhine there were a number of smaller stations that supplied current for power, not merely for factories but in houses and small shops. For instance, the station of Anrath, near Crefeld, supplied current to motors, each of not more than a quarter or a half horse power, used for silk manufacture in houses. The following figures are taken from the summary of the 939 stations. There were 766 stations with 257,243 kilowatts, using direct current; 45 stations with 30,550 kilowatts, using single or two-phase alternating current; 59 stations with 83,283 kilowatts, using three-phase current; two stations of 970 kilowatts with monocyclic systems, while 67 stations used a mixed system. Of the latter, 55 stations with 102,470 kilowatts used a combined three-phase and direct current system, while 12 stations with 8,041 kilowatts used a combined single-phase and direct current system. The 939 stations were situated in 906 cities; 552 stations with 316,235 kilowatts used steam power, 98 stations with 24,851 kilowatts used water power, and 61 stations with 6,378 kilowatts had gas engines. In one station, with 220 kilowatts, wind power was utilized; 196 stations with 41,861 kilowatts used both hydraulic and steam power. Of the 939 stations, 339 had a total capacity up to 100 kilowatts, 422 stations a total capacity between 101 and 500 kilowatts, 90 between 501 and 1,000, 39 between 1,001 and 2,000, 30 between 2,001 and 5,000 kilowatts, and 19 more than 5,000 kilowatts. There were in use 203,758 electricity meters.

It may be pointed out as suggestive, to say the least, that while we used 30,000 kilowatts of storage batteries, the Germans used 87,000 kilowatts; that they had 6,378 kilowatts capacity with gas engines, or six times as much as in the United States; and that they had 203,758 service meters compared with our 582,689, although our business is nearly four times as large as theirs. The German plants, like the English, also averaged larger than ours, namely, 420 kilowatts against 340.

A third country to serve as a gauge is Spain, which, backward as some people think it, shows up quite favorably from an electrical standpoint. In recent years electric light has come into very extensive use, not only in the houses of the more prosperous classes, but quite generally throughout the towns. There were installed 6,575 kilowatts in 1880, 12,762 in 1890, 78,475 kilowatts in 1901, and in 1903 about 100,000 kilowatts. This represents 5 watts per inhabitant. In Germany 438,772 kilowatts were installed in 1902; that is 7.5 watts per inhabitant. This compares with about 12 watts per head in England in 1902-3 and 16 watts per head in the United States in 1902. There are about 1,000 central stations in Spain, and the development of electric lighting has been especially rapid in Madrid and Barcelona. In the larger cities the three-wire, direct current system is mainly used with 200 volts between the outers, some plants using, however, alternating current. In Madrid, 16,600 kilowatts of machines and 17,700 kilowatts of storage batteries were installed, so that 66 watts were installed per inhabitant (against 48 watts per inhabitant in Berlin). Since 1890 the development of water power has steadily increased, alternating current being mostly generated and transmitted to a number of different towns. The profits of the electric stations are high, a dividend of 30 or 35 per cent. being nothing unusual. The methods of house wiring are very crude. Some high-tension transmission plants have recently been erected. The financial returns are to be envied.

(*To be continued.*)

Electric Power at the Hecla Mine.

Electric power from Spokane, Wash., has now completely supplanted steam at the Hecla mine at Coeur D'Alene, Idaho, and that well known property is operated by power transmitted 100 miles. The ore is now all mined and transported by electric power, while the mine is kept free of water by the same means. For this work about 220 hp. are required.

THE MECHANICAL STOKER AND THE HUMAN OPERATOR.*

BY EDWIN YAWGER.

The mechanical stoker is an accessory to an art, and the man who operates the stoker is an accessory to the same art. The mechanical stoker is not a thing by itself. It will not in any way alter the fundamental principles of the combustion of fuel. It is a part of a system, of which the air and gas passages, the baffles and the stack, as well as the operator, are correlative parts. Rankine, in his manual of the steam engine, enumerates 17 parts and appendages that go to make up a boiler furnace. His definition covers practically every part of a boiler equipment, except the vessel that contains the water and steam, and no builder of stokers should assume to offer his machine to a customer unless he is competent to submit a complete furnace design, properly calculated for the conditions of a particular case. Probably more failures have been due to neglect of this requirement than to inherent faults of stokers as machines.

It is evident from the broader view of the appurtenances of a furnace that the mechanical stoker is to be studied, not as a piece of machinery, but as an accessory in the art of fuel combustion.

The size of the plant.
The kinds of fuel available.
The type of boiler to be used.
The preliminary handling of fuel.
The conditions of service.
The design of all parts of a furnace, and
The character of the operator.

These are vital problems in the art, and a happy solution of all of them would greatly reduce the mortality record of the mechanical stoker.

Much of the literature on stokers and on combustion in general consists of records of various performances, in which, as a rule, some one feature is prominent and others more or less ignored. A vast majority of boiler trials are utterly unreliable, and even the most reliable contribute little assistance to commercial judgment.

Mr. Bryan Donkin, in his book Heat Efficiency of Steam Boilers, gives a careful analysis of 425 boiler trials. His conclusion from this array of data is best given in his own words:

"When making these summaries, the author at first thought he might be able to draw from them the conclusion that some one type would prove to be more economical than another.

"It is quite clear that much more depends upon how a given boiler, of whatever type, is worked, with clean or dirty surfaces, good or bad combustion, etc., than upon its form, internal or external fires, water or smoke tubes, or the particular way the differently shaped heating surfaces are presented to the furnace and hot gases."

When 400 trials, carefully selected and analyzed, fail to produce any general law, it is evident that another point of view is necessary for broad practical conclusions.

Leaving out, then, the question of detailed tests, it will be the object of this paper to present some of the general considerations that bear on the art of combustion of fuel in boiler furnaces.

The mechanical stoker, as a machine, must possess many points of excellence in order to contribute fully to net commercial economy. First and foremost, it must be so designed that it will continue to supply heat to the boilers in spite of accidents or unfavorable conditions of fuel and service. If heavy clinkers form they should be capable of easy disposal. If the actuating mechanism fails, it should be possible to continue firing by hand manipulation. If grates break it should be possible to replace them without drawing the fire. In addition to these primary requirements are the numerous details that must be worked out in all their relations before the full measure of fuel and labor economy can be realized.

I believe that next to the matter of continuous operation, the most important feature of furnace design lies in the handling of the air for combustion. A noticeable thing about records of boiler trials is the general lack of uniformity of results under apparently similar conditions. Unfortunately, the factor that enters most largely into this variation is seldom recorded, namely, the relative amount of air consumed. In furnace combustion the fact is often ignored that air is a fluid with a definite specific gravity and a consequent inertia.

No one would expect water mains to be efficient if constructed with a diversified cross section, sharp turns, and odd corners. Yet it is common to build furnaces in which the gases meet with improper deflection, unnecessary obstruction and restricted passages. Sometimes the ash pit and its doors are arranged in such manner that the air by its inertia seeks passage through a restricted area of the fire, usually the rear.

I have in mind one case where a hopper-bottom ash-pit being open at the front

*Paper read before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

furnished the principal channel for incoming air, which was directed against the rear of the fire, thus causing air-holes and a reduction in capacity and efficiency. In some cases a great loss in draft efficiency is caused by the clashing of burnt gases as they issue from various boilers into the smoke connection. I know of a case where two boilers were fitted with a vertical uptake, extending over both boilers. An increase of 25 per cent. in the efficiency of the draft was accomplished by placing a partition in the uptake, to separate the gases issuing from adjoining boilers.

It is a matter of common observation that there is frequently a considerable variation in draft in different furnaces where a number are connected to the same stack.

When the furnace is hand-fired, all the losses due to the improper manipulation of the air supply are rendered much greater. An indication of this can be obtained by noting by means of a gauge the variation of draft in the fire chamber during a cycle of firing.

I believe it is the practice of boiler manufacturers to establish a fixed arrangement of baffles. The furnace specialist goes further than this, and arranges the baffles to conform to the nature of the service, and the amount of draft in the particular case.

Accessibility is a prime requisite, and that stoker will give the best service in which the condition of the fire can be seen, and obstructing clinkers dislodged without the opening of doors.

In view of the prevailing tendency toward the use of large boilers, stoker design must permit of a corresponding expansion of grate surface. In many cases 500 hp. or 600 hp. boilers, instead of being fitted with the proper amount of grate area, as determined by the draft and weight of coal to be burned, are expected to give results on a restricted grate, simply because the design does not permit the proper area.

The data at hand on the question of durability offer, if possible, a wider range than above indicated for boiler trials in general.

The peculiar thing about reports of stoker repairs is that records cover only the two extremes of experience. In a few plants the small cost of repairs being a matter of pride, a segregated record is kept of stoker repairs. In other plants, more unfortunate in design and operation, excessive repairs are often reported. The range in this respect varies from half a cent or less per ton of coal fired, to 12 cents in extraordinary cases. In the large majority of plants between these extremes there is no record available.

It should be noted that the life of a boiler and a furnace should be logically reckoned, not by the year, but by the gallons of water evaporated and the number of tons of coal consumed.

The foregoing requirements are generally understood and accepted.

Other questions of furnace design no doubt have two sides, with advocates for each. A number of makers construct furnaces calculated to reject the refuse continuously and automatically, the argument being that this reduces the labor required and adds to the effectiveness of the operation. On the other hand, it is claimed that continuous discharge will carry over a considerable amount of combustible when fires are forced, while with light firing there will be a thin zone in the fire near the discharge point that will admit an excess of air; also that large clinkers will occasionally fail to pass through an otherwise automatic discharge.

The extent of the fire-brick arch over the fire in furnaces operating with progressive feed is sometimes subject to discussion. The presence of an arch sufficient to reflect heat on the fuel until it is well coked is always recommended. It is argued, however, that the external fire chamber, with its full-length arch, throws back all of the radiant heat upon the fire, thereby increasing the rapidity of combustion and insuring its completeness. Other authorities state that it is better to expose the heating surface promptly to the highest possible temperature, to this end making use of a large proportion of direct radiation. Rankine states that about one-half of the total heat from the combustion of coal is given up in radiation. The open fire, therefore, would project a greater quantity of heat against the first row of tubes, with a tendency to intensify evaporation at that point. Experiments made by the Northern Railway Company of France showed that evaporation around the fire-box of a locomotive boiler averaged seven times as great per square foot of heating surface as the rate in the flues.

There is no increased danger to boiler tubes by reason of high temperatures. The rupture of a tube is invariably due to some cause within itself, either a flaw in material or the presence of scale sufficient to interfere with the releasing of steam. With these facts in mind, and with a view to reduce as far as possible the loss by external radiation and air leakage; it seems the logical thing to design an arch deep enough to insure the absence of combustible gases in the flues, at the same time permitting a liberal amount of direct radiation.

Judging from the number of 60-foot stacks in use, especially in steel works, there would appear to be a wide difference of opinion on the subject of draft. If I were asked to specify a single improvement in furnaces that would net a greater saving than any other, the reply would be "double the height of all the stacks now in use." Intensified draft will work wonders.

First—It will permit the burning of more coal per square foot of grate, thereby increasing furnace temperature. The burning of more fuel per square foot of grate service, and the consequent high temperature, is in itself an element of economy, illustrating one of the fundamental laws of thermodynamics, which states that efficiency is dependent on the range of temperature in the working medium.

Second—It will make combustion complete at a point nearer the coal; that is, the flame will be shorter and the excess of air will be less. This condition is due to the fact that a strong draft rushes among the fuel at high velocity, causing a more intimate mixture of air with the inflammable gases.

Third—The same volume of gas at the same temperature will give up more of its heat when passed rapidly than when passed slowly over the same heating area. Many experiments have been made to determine a law governing the effect of speed on the liberation of heat from gases, but the results are variable. All agree, however, that the effect is important.

It is plain from this that the stack or draft apparatus has a function not usually accorded to it, namely, that of overcoming friction in gas passages induced by high speed of gases. It is considered by many a point of good management to reduce as much as possible the internal friction in furnaces, but if this is done at the expense of speed of gases, the result will be a reduced capacity and a higher stack temperature.

Lack of space forbids taking up other points that are quite well known but often overlooked. For instance, that soot is more fatal to economy than is scale, but not so fatal to boilers, and that under no circumstances does water do duty as fuel.

It is common experience that no part of a power plant is subject to so much neglect as are the boilers. The reason for this lies in two inevitable weaknesses of human nature.

First—A reluctance to perform a dirty and disagreeable task.

Second—A reluctance to perform any task when its results are not apparent to the observation.

An engine operator may build up a reputation by giving such attention to his engines that they will not offend the eye or the ear of the observer. The chances are that if his engine looks clean and runs quietly, it is in fact in good order; but the external cleanliness of a boiler would argue little as to the absence of scaled tubes, soot-choked passages or broken-down baffles.

Some years ago I became partly responsible for the operation of a large mechanically fired plant in Pittsburg. There were 16 boilers in the plant, and I was asked to determine why it seemed impossible to secure sufficient steam for the engines. I made a brief examination of the boilers, and found that the stack draft in the different batteries ranged from .45 inch to .7 inch of water, and that stack temperatures varied from 450 degrees to above 700 degrees. The general condition inside the furnaces seems obvious. I agreed with the management to pick out a man who would enter their employ and have full charge of the boiler plant, with the expectation that a change would soon be apparent. An inspection by this man showed that in some cases soot had accumulated in such quantities as to choke the gas passages. This explained the low draft and temperature in some of the stacks. In other cases the baffles were broken down and displaced to such an extent that the gases made practically one pass through the tubes and escaped at high temperature. This gave the key to the other extreme stack condition. It was found, by a little close observation, that the attendants reported the external cleaning of the tubes without going through the formality of doing the work. A short period of personal supervision served to put the plant in such condition that steam was easily supplied by 14 boilers instead of 16. This happened in a stoker-fired plant; it would have been worse in a hand-fired one, because the same human nature would have been there, only more of it. It is evident that such delinquencies on the part of attendants work equally disastrous results, whether the plant is stoked by hand or by machine.

There is another phase of human nature that has an important bearing on the comparison of hand versus machine firing which probably furnishes the stoker manufacturer with his strongest argument in favor of the superior fuel economy of the mechanical stoker. It is the well-known fact that there is a wide variation in the efficiency of individual firemen in the actual manipulation of the fires. I am told by the superintendent of motive power of one of our greatest railroads that his company has for a long time maintained a system of rewards, based on the economy in coal obtained by the different locomotive firemen. Basing observations upon the records of a large number of firemen, who have been under the system long enough to establish a personal average, it is found that certain individuals maintain a higher average of rewards than others throughout a long period of service. If, therefore, the company could secure a force of firemen, each one of whom could equal the best average, there would be a saving in fuel amounting to many times the sum required for premiums.

One universal result of the substitution of mechanical for manual methods consists in a greater uniformity of product, and from the nature of the operation it is possible to maintain a stoker at or near its highest efficiency. To obtain this very desirable condition it will be necessary to start right by making a competent engineer responsible, not only for the selection of the machine, but for the unity of design of the entire furnace from ash-pit to top of chimney.

To maintain a boiler plant at its highest efficiency is not a complex problem, but enough has been said to show that it requires constant and intelligent supervision. It is its capability of responding to intelligent supervision that renders mechanical stoking superior to the human kind. The functions of the machine are varied, when necessary, by positive adjustments, and changes in adjustments can be governed by definite rules easily within the comprehension of the dullest operator. I should say in general that any chief engineer of a station, who himself is capable of operating successfully a mechanical furnace, can, with a reasonable amount of attention, secure uniformly good results throughout a large plant.

Recording instruments of various kinds will be found useful, especially in mechanically fired plants. Probably the most useful record obtainable in connection with furnace operation is a record of the amount of air supplied. With the uniform conditions due to mechanical stoking, such a record gives a fair indication of the degree of efficiency of the furnace. This record is obtained in many plants by an apparatus for the continuous analysis of flue gases. The use of a draft gauge, attached permanently and showing the draft in the fire chamber, will give an approximate idea of the amount of air consumed. A diminution in draft at this point indicates air holes and an excess of air, while a great increase will indicate too great a thickness of fire and a probable presence of CO in the flue.

It will be noticed that an expert stoker fireman, in running a test, will keep his fire gauge at that point which indicates the proper thickness of fire.

A proper appreciation of any art is obtained by a study of its masterpieces, and an engineer who has full knowledge of all that contributes to the success of the best actual installation will be best able to duplicate that success in other situations.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE III.

BY W. H. WAKEMAN.

As several rules and formulas for determining safe pressures are to be presented in this series, it is necessary to apply all of them to either one or the other of two boilers which are alike, except that one is made of steel and the other of iron. in order to compare results from a fair standpoint. For this purpose the following conditions are assumed:

Diameter of boiler—72 inches.

Thickness of plate—.5 inches.

Strength of joint—.75 inch.

Tensile strength of steel plate—60,000 pounds.

Tensile strength of iron plate—50,000 pounds.

Factor of safety—5.

The first to be presented is designated as Formula No. 1, for steam boilers:

$$\frac{62,720 \times r \times 2 \times T}{D \times F} = W.$$

62,720 = tensile strength of steel plate.
r = strength of joint.
T = thickness of plate.
D = diameter of boiler.
F = factor of safety.

In this case the tensile strength is given direct, and is slightly in excess of the amount stated in the first data given. The reason for this is that in England it is customary to state the tensile strength in tons, and experiments made on steel plates show that it varies from 27 to 32 tons per square inch of sectional area. It is the same whether the strain is applied lengthwise or crosswise of the plate, because steel differs from iron, as it has no grain to be taken into consideration.

This formula assumes it to be 28 tons, or $2,240 \times 28 = 62,720$ pounds, but it might have been taken at 60,000 pounds

without error, as it would be a reduction of about one ton, bringing it down to the lower limit given.

When applied to the boiler described it gives the following result:

$$\frac{62{,}720 \times .75 \times 2 \times .5}{72 \times 5} = 130.67 \text{ pounds.}$$

Formula No. 2, for iron boilers:

$$\frac{47{,}000 \times r \times 2 \times T}{D \times F} = W.$$

This agrees with the preceding except that the tensile strength is reduced to 47,000 pounds or 21 tons. Experiments made on English iron plates show that the tensile strength across the grain is from 19 to 23 tons, and with the grain from 20 to 23 tons. The former is not considered here, because the grain of iron plates is so placed that the strain across it is usually less than one-half of what it is with it, therefore it is always well within the safe limit.

Applying this gives the following safe working pressure:

$$\frac{47{,}000 \times .75 \times 2 \times .5}{72 \times 5} = 98 \text{ pounds.}$$

The reader who is really interested in this subject will want to know how to apply the principles of this formula to determine the value of other factors when the safe working pressure is given. For this purpose the following are presented for use where the tensile strength of plate, strength of joint, thickness of plate, diameter of boiler and factor of safety are required. Explanation already given of the letters applies to these. For convenience of operation S = tensile strength:

No. 3. $$\frac{W \times D \times F}{T \times 2 \times r} = S.$$

No. 4. $$\frac{W \times D \times F}{S \times 2 \times r} = T.$$

No. 5. $$\frac{W \times D \times F}{S \times 2 \times T} = r.$$

No. 6. $$\frac{S \times r \times 2 \times T}{W \times F} = D.$$

No. 7. $$\frac{S \times r \times 2 \times T}{D \times W} = F.$$

Another English authority gives a formula for determining the strength of boiler shells, which is identical with No. 1 for steel boilers, and with suitable modification it can be used for iron boilers the same as No. 2, except that there are 25 reasons given for changing the factor of safety.

As these are given for the benefit of inspectors in charge of boiler construction, and many of them cannot be intelligently used by others on boilers already in use, they will not be quoted here, but the following illustration is presented as a matter of interest.

When the rivet holes are not fair in the longitudinal seams .75 may be added to the factor of safety. As any addition makes the safe pressure less, this formula with its variations reduces the pressure to suit the quality of workmanship.

The following formula possesses peculiarities which require explanation:

Formula No. 8, for steel boilers:

$$\frac{C \times (16t - 2) \times R}{D.} = P.$$

C = 21 when the seams are fitted with butt straps of equal width. (See Fig. 5.)

C = 20.25 when one butt strap takes one more row of rivets than the other. (See Fig. 6.)

C = 19.5 when a double riveted lap joint is used. (See Fig. 7.)

For steel rivets:

No. 10. $$\frac{N \times A}{P \times T} \times 85 = R.$$

For iron rivets:

No. 11. $$\frac{N \times A}{P \times T.} \times 70 = R.$$

P = pitch of rivets.
D = diameter of boiler.
N = number of full rows.
A = area of one rivet in single shear.

For rivets in double shear this becomes A × 1.75. Assuming that the pitch is 3.25 inches, diameter of rivets .875 inch, two rows of rivets, area of one rivet .6 square inch, and thickness of plate .5 inch, making a double riveted lap joint, the following results are secured by applying these formulas:

No. 9. $$\frac{3.25 - .875}{3.25.} \times 100 = 73.$$

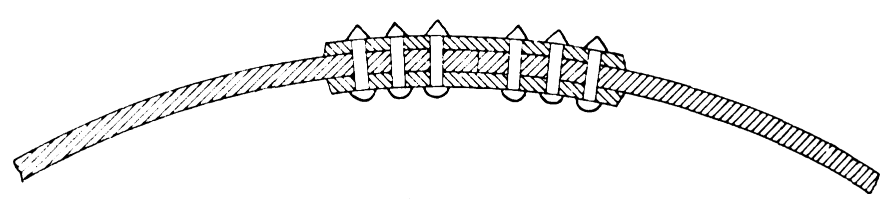

Fig. 5.

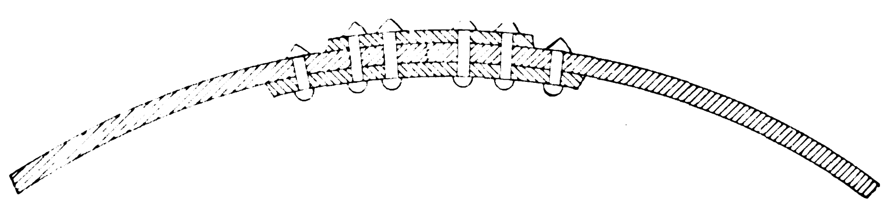

Fig. 6.

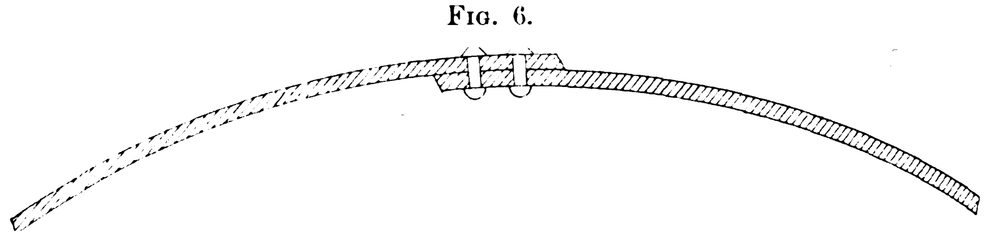

Fig. 7.

t = thickness of plate in inches.
R = the strength of joint taken as a whole number.
D = diameter of shell.
P = safe working pressure.

Values of the constant C are based on a tensile strength of 27 tons per square inch of sectional area. If it is more the constant may be increased accordingly. As we have assumed 60,000 pounds for this factor, which is equal to 26.78 tons, there is not enough difference to materially change the constant.

Special directions are given which direct us to determine the value of R by the following formulas:

For steel or iron plates:

No. 9. $$\frac{P - D}{P} \times 100 = R.$$

No. 10. $$\frac{2 \times .6}{3.25 \times .5} \times 85 = 63.75.$$

No. 11. $$\frac{2 \times .6}{3.25 \times .5} \times 70 = 52.5$$

For a steel boiler with steel rivets this formula gives the following safe working pressure. The value of R as given by Formula No. 10, used as the strength of rivets, is less than the solid plate between the rivets, as shown by No. 9. See Fig. 7.

$$\frac{19.5 \times (16 \times .5 - 2) \times 63.75}{72} =$$

103.6 pounds.

This is a low pressure for the kind of boiler mentioned, but that brings it on the safe side. If the constant 2 in Formula No. 8 is omitted it gives results nearer to what is considered good American prac-

tice, as the safe pressure in this case would be 138 pounds.

When this is to be applied to an iron boiler the value of C is changed to meet the lower strength of iron plates. For steel plates it is 27 tons and for iron plates 21 tons, therefore the value of C is found as follows:

$$19.5 \div 27 \times 21 = 15.16.$$

Using this for an iron boiler shows the

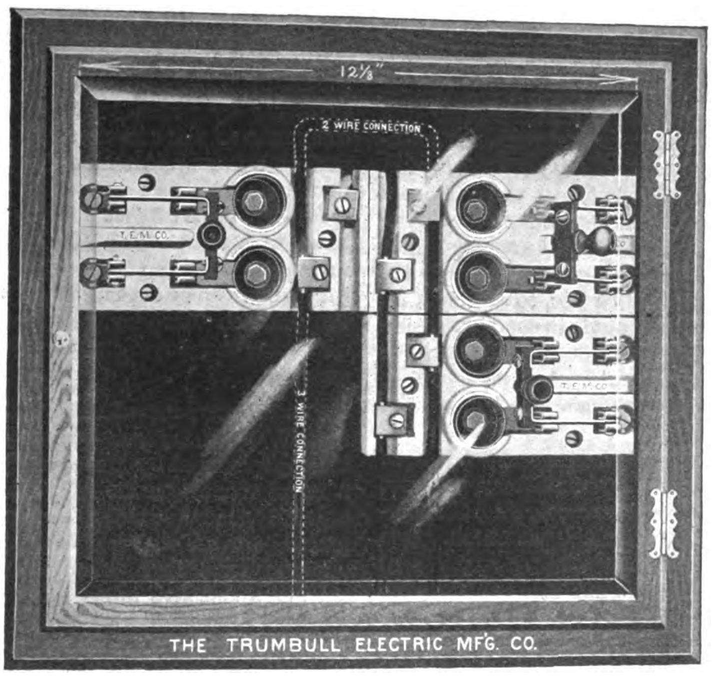

FIG. 2.—TRUMBULL PANEL BOX.

difference caused by change of material.

Formula No. 12, for iron boilers:

$$\frac{15.16 \times (26t - 2) \times R}{D.} = P.$$

Applying this to the 72 inch boiler gives a lower safe pressure:

$$\frac{15.16 \times (26 \times .5 - 2) \times 63.75}{72} =$$

80 pounds.

Striking out the constant 2 as before mentioned raises this to 107 pounds.

Trumbull Panel Cutouts.

Fig. 1 herewith shows a 15-ampere, 110-volt panel cutout brought out by the

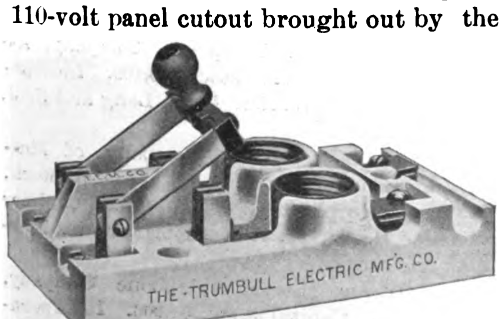

FIG. 1.—PANEL CUTOUT.

Trumbull Electric Manufacturing Company of Plainville, Conn. The particular advantage claimed for this cutout is the fact that it can be used for either the two or the three-wire system and for any number of circuits. Fig. 2 shows three panel cutouts in a panel box, with connections for two-wire and three-wire systems indicated. In the former, both wires go up on one side and continuing over go down on the other, while in the three-wire system, the neutral wire goes up on one side and crossing over goes down on the other, the outer wires terminating at the top. The manufacturer calls attention to the fact that any size of panel-board can be made up from stock with the aid of these cutouts. The individual panels are 3 inches by 6 1-16 inches, and when arranged in a box would take up 12⅛ inches. Each additional circuit would therefore add 3 inches to the length of the box. Each panel includes both switch and cutout, and when used with inclosed fuses conforms to the underwriters' requirements.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 24, 1904.

Electric Railways and Appliances.

760,556. Motor-Car. Alexander Palmros, Columbus, O., assignor to the Jeffrey Manufacturing Company, same place. Filed Sept. 5, 1900.

760,641. Trolley-Pole. Alfred W. Morgan, Longbeach, Cal. Filed Nov. 16, 1903.

760,643. Third-Rail Guard for Electric Railways. Vincent M. Newman, Bayside, N. Y. Filed Feb. 16, 1904.

760,656. Electric Track-Switch-Operating Mechanism. Charles W. Squires and James B. Squires, Springfield, Mass. Filed Jan. 20, 1903.

760,662. Car-Fender. Peter B. Sullivan and George F. Taylor, Randolph, Mass. Filed Sept. 2, 1903.

760,736. Trolley-Pole Head. John E. Greenwood, Utica, N. Y. Filed Sept. 25, 1903.

760,737. Safety-Clamp for Rails. Thomas J. Harleman, Packerton, Pa. Filed March 28, 1904.

760,781. Car-Fender. John C. Cooper, Baltimore, Md. Filed March 4, 1904.

760,801. Automatic Trolley-Controlling Device. Horace W. Nichols, Philadelphia, Pa. Filed Sept. 9, 1903.

760,828. Trolley. John S. Weckman and Robert J. Millard, Carnegie, Pa. Filed Oct. 17, 1903.

760,846. Electric Railway-Switch. Rupert L. Border, Pittsburg, Pa. Filed Oct. 15, 1903.

760,947. Electric Bond for Railway-Rails or Other Conductors. John S. Alexander, New York City. Filed Feb. 25, 1903.

761,000. Trolley. James A. Lavery, New York City, assignor of one-half to George F. Allen, Brooklyn, N. Y. Filed Nov. 7, 1903.

Electric Lights and Appliances.

760,603. Electric Switch. Henry P. Ball, New York City, assignor to the General Incandescent Arc Light Company, same place. Filed July 5, 1902.

760,657. Portable Electric Hand-Lamp. George Stein, New York City. Filed July 18, 1903.

760,789. Vapor-Electric-Lamp Manufacture. Peter C Hewitt, New York City, assignor to the Cooper Hewitt Electric Company. Filed Dec. 4, 1903.

Electrical Machinery and Apparatus

760,426. Alternating-Current Wattmeter. Frank Conrad, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 20, 1903.

760,480. System of Electrical Distribution. John S. Peck, Pittsburg, and Joseph W. Farley, East Pittsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed July 3, 1903.

760,565. Electrical Switching Apparatus. Walter J. Richards, Milwaukee, Wis. Filed April 29, 1903.

760,568. Electric Indicator. Edward Sadler, Upper Tooting, England. Filed Feb. 16, 1902.

Telephones and Telephone Apparatus.

760,573. Telephone-Exchange System. Charles E. Scribner, Jericho, Vt., assignor to the Western Electric Company. Filed Sept. 15, 1902.

760,574. Electric Pole-Changer. Charles E. Scribner, Jericho, Vt., assignor to the Western Electric Company. Filed Sept. 15, 1902.

760,711. Automatic Telephone System. James C. Slater, St. Louis, Mo. Filed March 10, 1902.

Miscellaneous.

760,463. Wireless Signaling System. Guglielmo Marconi, London, Eng., assignor to the Marconi's Wireless Telegraph Company, Limited, a Corporation of Great Britain. Filed Sept. 10, 1903.

760,561. Process of Manufacturing Hard Porous Electrodes for Batteries. Heinrich P. R. L. Porscke and Gustav A. Wedekind, Hamburg, Germany. Filed Nov. 18, 1903.

760,611. Printing-Telegraph Receiver. George A. Cardwell, New York City, assignor to Frederic J. Swift, trustee, same place. Filed April 11, 1903.

760,653. Thermostatic Controller. Johann F. Siems, Columbus, Neb. Filed Oct. 18, 1902.

760,658. Circuit-Breaker. Charles F. Stoddard, Boston, Mass., assignor to the American Pneumatic Service Company, Dover, Del. Filed June 8, 1903.

760,679. Circuit-Breaker. John Burry, Ridgefield Park, N. J. Filed Aug. 30, 1902.

760,712. Storage-Battery Plate. Edward W. Smith, Philadelphia, Pa., assignor to the Electric Storage Battery Company. Filed Sept. 10, 1903.

760,714. System of Electrical Distribution. William A. Turbayne, Lancaster, N. Y., assignor to Charles M. Gould, New York City. Filed Nov. 2, 1903.

760,787. Electric Mail and Package Carrying Device. Edward G. Hamilton, Richmond, Ind., assignor of two-thirds to John G. Hamilton, and Leroy E. Hamilton, same place. Filed July 28, 1902.

760,794. Electrical Bathing Apparatus. Robert S. Lawrence Boston, Mass., assignor to the Consolidated Inventors' Corporation, same place. Filed Aug. 3, 1903.

760,798. Circuit-Breaker. Andrew C. Miller, Corona, Cal., assignor of one-half to Frank Chase, same place. Filed May 19, 1902.

760,810 Motor-Vehicle. Semple S. Scott, St. Louis, Mo., assignor to the Electric Auto-Chair Company, same place. Filed Aug. 5, 1903.

760,897. Storage-Battery Plate. Achille Meygret, Paris, France, assignor to Edward T. Magoffin, New York City. Filed June 29, 1903.

760,955. Electric Signaling System and Apparatus Employed Therein. Robert G. Callum, Washington, D. C. Filed Oct. 11, 1902.

760,970. Means for Controlling Electric Currents. Isidor Deutsch, Montreal, Can., assignor to the Electric & Train Lighting Syndicate, Limited, same place. Filed April 30, 1902. Renewed June 25, 1903.

760,976. Electric Signal System. Otto Ernst, Larchmont, N. Y. Filed Sept. 22, 1903.

761,039. Insulation for Transformer-Coils. Charles Le G. Fortescue, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 30, 1903.

THE TELEPHONE WORLD.

Nebraska Independent 'Phone Men Plan System.

The Round Grove Telephone Company, recently organized to do business in Sherman and Custer Counties, selected the following officers: R. R. Martin, president; A. M. Ramery, vice-president; C. W. Martin, secretary; L. C. Smith, treasurer; W. H. Duncan, L. J. Smith, W. L. Shaffer, executive committee.

This company is pushing the work of erecting poles, putting on the wire and installing telephones. The object is to extend the lines in all directions to connect with Independent lines in the State, and to establish a main line to connect with large towns and cities, thus enabling all who own telephones to connect and do business all over the State at a cost probably not to exceed 50 cents per month for each member.

As soon as a majority of the Independent companies indicate a desire to call a convention to formulate plans and to organize to run main lines so as to connect all Independent lines, such a convention will be called to meet at some convenient point.

The Tennessee Railroad Commission met recently and assessed the Weakley Telephone Company for the years 1903 and 1904. The property of the company was assessed at $8,000, and the assessment was at once certified to the State Comptroller. The assessment of this company was not made when other telephone property was assessed for the reason that it failed to furnish schedules within the time required.

The regular monthly meeting of the Flushing, N. Y., Association was lately held. District Superintendent Van Benschoten, of the New York & New Jersey Telephone Company, was present at the meeting to listen to complaints in regard to the service, and made a short address in which he promised an improvement in the service and announced that the new schedule of rates will go into effect today.

Two companies for furthering and promoting telephone interests in Eastern Montana filed papers of incorporation recently. One known as the Billings Mutual Telephone Company and the other the Billings Telephone Construction Company. P. B. Moss, one of the incorporators, says the former is intended to take over the Moffet local exchange.

The Southern Telephone Construction Company, which installed the new automatic system in Columbus, Ga., has completed its contract and turned the system over to the local company. John T. Norman is president of the home company. The contract with the construction company called for 700 'phones in actual operation. This has been exceeded by 300, and 1,000 instruments will shortly be in operation.

The Leigh, Neb., Independent Telephone Company has been organized, the principal promoter being F. E. Bell, secretary of the Wayne Independent Telephone Company.

The annual meeting of the stockholders of the Northeastern Telephone Company will be held in Thompson, Pa., June 9.

Covington, Tenn., Now Has Telephone Service.

The differences between the board of mayor and aldermen and the Cumberland Telephone Company at Covington have been adjusted. On account of the demand of the board for a rental of $1.50 per annum on each telephone poll within the corporate limits, the telephone company closed its office at Covington May 10. Since that date the city has been without 'phone communication with the outer world, and a number of boxes had been taken out of business offices and residences. Notice had been given that the company purposed withdrawing entirely from the city. Officers and counsel from Nashville met with the board and effected a satisfactory adjustment of the differences. The board receded from its demand for a pole rent. The company agreed to furnish five free 'phones for the city's use, to establish an exchange at Mason and put it in communication with Covington and place both towns on the free list, besides maintaining their present free lists with towns and villages throughout the county.

The Memphis Telephone Company has been endeavoring to effect a satisfactory contract with the city authorities ever since the Cumberland company closed its office, but failed. It is understood that the Memphis company will establish a long-distance toll line to Covington at an early date.

Will Combine With Troy Telephone Company.

The stockholders of the new Union Telephone Company of Glens Falls. N. Y., have voted to consolidate with the Troy & Saratoga Independent companies. Stock valued at $90,000 was represented at the meeting. The vote was unanimous.

Capitalists of Arapahoe, Neb., incorporated as the Arapahoe Independent Telephone Company, with an authorized capital of $20,000, although but $3,000 has so far been expended, lately opened for business one of the most complete plants in the State, with 64 'phones connected by separate wire with a central switchboard. Twenty more drops will be added at once. One line is to run southeast eight miles, one north ten miles, and one to Holbrook, six miles, to connect with the Cambridge Independent 'phone line from the west. It is the intention of the incorporators to extend country lines in every direction from Arapahoe where desired and to furnish 'phones at a nominal price in the interests of the town rather than for profit. There is now $2,000 cash on hand to extend the system, and as much more as may be necessary to make it complete in every particular.

The Penn Yan, N. Y., Telephone Company has established a rural produce exchange for the use of its patrons. There are over 200 rural subscribers connected to this exchange, and there are 200 more telephones contracted for.

Long distance telephone communication has been established between Washington, D. C., and Bluemont, Round Hill, Purcellville and Hamilton, Va., on the Bluemont branch of the Southern Railway.

Kinloch Company to Build.

The Kinloch Telephone Company of St. Louis, Mo., has bought the site at the northwest corner of 10th and Locust streets, for $200,000, and will at once proceed to erect there a 12 to 15 story building, at a cost of $850,000.

The deal was directed, it is understood, by the Mississippi Valley Trust Company as financial agents for the Kinloch Company.

Financial arrangements are being made by the Kinloch Company with a St. Louis banking syndicate by which, with other Independent companies of the country, it will be enabled to perfect a transcontinental long distance telephone system.

It is with this project in view that new quarters are sought. The Kinloch Company will retain the four top floors of the new building for its own office exchange. Within 10 months the Kinloch Company is expected to have its new home completed and move from its present quarters.

The effectiveness of the system of the Corning, N. Y., Telephone Company is being constantly increased by Manager Frank Cross. By a move recently made Mr. Cross has brought over 200 'phones into the service that were operated as an Independent farmer system running from East Caton to Seeley Creek, a station about five miles south of Elmira, and covering a large district southeast of Corning. A contract has been signed with Palmer & Pratt to build a line from Corning to Caton Center where the Independent farmer system will be connected with the Corning Company's line, which will place the newcomers in communication with all of the towns that are on the lines of the Corning company.

Probate Judge Hall, of Baldwin county, Ala., has filed with the Secretary of State the certificate of incorporation of the Eastern Shore Telephone Company, composed of members of the single tax colony of Fairhope, who will build a telephone system for their convenience.

A telephone service from Pendleton, Ore., out to Birch Creek, accommodating a large number of families, is to be established this season.

The Twin City Telephone Company has completed its line to Lake City, giving connection with its entire system.

Telephone Incorporations.

The Assumption Telephone Company, Assumption, Ill. Capital stock, $2,400. Incorporators: Silas S. Shafer, I. L. Long and S. J. Long.

The Gilbert Telephone Company of Muskingum County, Gilbert, O. Capital stock, $2,000. Incorporators: E. L. Roe, Chalmer Menefee, H. L. Nye, J. D. Thomas, W. M. Bateman and others.

The Ottawa Mutual Telephone Company, Ottawa, O. Capital stock, $1,000. Incorporators: C. O. Beardsley, J. H. Purnell, P. E. Smith, E. L. Tupper and George Fritz.

The Northern Union Telephone & Telegraph Company, Potsdam, N. Y. Capital stock, $50,000. Incorporators and directors for the first year: William M. Booth, A. B. Thomson and R. W. Seinner, Syracuse, N. Y.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albany, N. Y.—The Kings County Lighting Company was incorporated last week with a capital of $2,000,000, to manufacture and supply gas and electricity in Brooklyn and Queens Boroughs. The directors are Ashley T. Cole and Charles T. Lark, of New York City; William J. Bagnell, of Bayonne, N. J.; Alex. Keogh, of New Rochelle, and W. R. Fuller, of Brooklyn.

Algona, Ia.—Boilers and engines will be added to the electric light plant at this place.

Arapahoe, Neb.—The Arapahoe Independent Telephone Company assures the citizens that electric lights may be an adjunct of its efforts this summer.

Brewster, Minn.—This village has voted $7,000 worth of bonds to be sold and the money thus obtained to be used in building a system of waterworks and an electric light plant.

De Leon, Tex.—C. L. Rucker, of this place, who recently put in waterworks will soon furnish electric lights.

Golconda, Ill.—H. V. Hesselman, city clerk, reports that an electric light plant will be erected here.

Hempstead, N. Y.—The town board has voted unanimously to establish the Merrick lighting district and bids for lighting the territory included in its boundaries will be opened June 27. The district established will extend from the railroad south to Merrick road and the water front. Incandescent electric lights are to be used.

Hopkinsville, Ky.—The electric light plant owned by the Hopkinsville Gas & Lighting Company, was lately destroyed by fire.

Houston, Minn.—This town will issue bonds to the amount of $9,000 for the construction of an electric light plant and waterworks system.

Kingman, Kan.—This town has granted a franchise for an electric light plant.

Long Island City, L. I.—A large new $10,000 power house is to be erected for the Astoria Light, Heat & Power Company,

Manton, Mich.—The proposition to bond this village for $8,000, to increase and extend the electric light plant and waterworks, was carried at a recent election.

McKinney, Tex.—A special election will be held here June 14, for the issuance of bonds to the amount of $8,000, for installing an electric light plant.

Media, Pa.—This borough has been bonded for waterworks and a new electric lighting plant.

Mexico, City, Mex.—Engineers Weissel & Hock have signed a contract with the owners of the Alfarena Mine in the Santa Barbara district to establish an electric light plant with a capacity of 100 hp.

Mitchell, Ill.—The proposition to raise $10,000 for electric lights and waterworks improvements was carried at a recent election.

Mitchell, S. D.—The Electric Company intends to double the capacity of the lighting plant to meet the demands that are constantly being made for incandescent lights. The capacity will be increased 2,000 lights.

Myrtle Beach, S. C.—The management of Myrtle Beach has decided to put in electric lights for the summer.

Palmyra, Mo.—Extensive improvements are to be made in the plant of the Palmyra Light & Power Company.

Stanberry, Mo.—An ordinance granting to F. A. Weimer the right and privilege to erect and maintain an electric light works was lately passed.

Stoughton, Wis.—A new electric light plant is to be established here.

Terre Haute, Ind.—The Terre Haute Electric Traction Company has changed its corporation name to the Terre Haute Traction & Light Company, capitalized at $3,000,000. It will build an electric line and also supply several cities with electric power for lighting purposes.

Troy, Ida.—Without doubt this city will have a waterworks system and electric light plant before fall. The matter is in the hands of the business men and city officials.

Waupaca, Wis.—The Waupaca Electric Light & Railway Company has increased its capital stock from $75,000 to $125,000.

STREET RAILWAYS.

Albuquerque, N. M.—Roderick Stover, electrical engineer, is superintendent of the construction of the electrical portion of the Albuquerque Street Railway.

Bucyrus, O.—Work on the Marion-Bucyrus electric line will be commenced some time this month.

Cleveland, O.—The Cleveland Electric Railway Company has been granted a franchise to extend its line.—Promoters of interurban electric railways will soon leave this city and go over the several trolley roads as far as Westfield, N. Y. The purposes of the trip will be to promote the extension of the lines now in operation through Buffalo. The cities on the lines already in use are Cleveland, Painesville, Ashtabula and Conneaut, O.; Erie, Pa., and Westfield, N. Y.

Deposit, N. Y.—H. Wilson, of Rutherford, N. J., is interested in the proposed electric railroad from here to Cannonsville.

Edgerton, Wis.—The Southern Interurban Company is surveying for an electric line between Janesville and this city.

Grand Saline, Tex.—An interurban electric railroad about 65 miles long, is to be constructed between Dallas and this place. A strong company is being organized for the purpose of building and operating the road. It will pass through a number of towns and traverse the most populous section of the State. There are salt works here, and it is reported that one object of the proposed road is to handle this freight in addition to passenger business.

Indianapolis, Ind.—The Chicago & Northern Indiana Railroad Company recently incorporated, will build an electric railway from Chicago to this city through Lake, Porter, Jasper, Pulaski, White, Cass, Howard, Clinton, Tipton, Hamilton and Marion Counties into Indianapolis over a private right of way. The directors are Lester Soule, A. L. Wheeler and Senator Charles N. Thompson, of this city; Henderson E. Davenport, Sheridan; James G. Kemp, Kempton; Martin W. Elkenbury, Russiaville and Luther McDowell, Young America. The nominal capital stock is $25,000. It is said that millions are back of the project.

Jeffersonville, N. Y.—William P. Craig, of Orange, the Liberty-Jeffersonville trolley promoter, was here lately. He claims now to have the full control of this project, and says that work will soon be commenced and the road put through.

La Crosse, Wis.—W. W. Cargill and W. S. Cargill are the principal stockholders in the La Crosse & Southeastern electric road planned to run between here and Viroqua.

Monmouth, Ill.—The Western Illinois Traction Company has secured the right of way to build a line between this city and Galesburg.

New York City.—This city and Philadelphia are now connected by an electric road.

Niagara Falls, N. Y.—The Thorold & Lake Erie Railway Company, which is allied to the Wolvin Syndicate, the great grain shippers and lake vessel owners, has a bill before the Canadian Parliament to permit it to construct an electric railway from Thorold to Welland and thence to Port Colborne and Buffalo; also a line to Brantford. The idea is to operate the trolley line so that passengers passing through the Welland Canal on any of the Wolvin Company's boats, may make a side trip to the Falls by trolley and meet the boat further down the canal.

Peoria, Ill.—An electric street car line from Prospect Heights, over the precipice to the river, will be built. Surveys are being made for this enterprise. The route is practically selected.

Plano, Ill. Mr. Grote, of Elgin, is interested in the new electric line here.

Reading, Pa.—Great progress is being made in the construction of the new trolley line between Birdsboro and this city and cars will be run about July 1.

Springfield, Ill.—The American Central Traction Company, capitalized at $210,000, is the name of a newly proposed interurban railway, which will construct a line from Taylorville to Assumption. The incorporators are E. Hoover, J. E. Hogan and others.

Stillwater, Minn.—The Western Gas & Improvement Company will construct an electric line between Apple River Falls and this place.

St. Paul, Minn,—The Pioneer Electric Company has been organized here to build an electric line from South St. Paul to White Rock. Its capital stock is $100,000, and directors H. F. Johnson, A. W. Holmes and others.

Wauconda, Ill.—The Milwaukee Electric Railway Company is trying to secure a franchise through this place.

POWER PLANTS.

Cincinnati, O.—Charles Fisher will erect a large electrical power plant on the east side of Reading Road.

Nooksack, Wash.—The Washington Mining & Development Company will install an electric plant near here.

Peru, Ind.—Jerome Herff, president of the Indiana Hydraulic Company, states, according to local reports, that plans and specifications will soon be ready for bids for constructing a dam, power plant and an electric line between Vincennes and West Baden.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 13@13⅛c.; Lake 13⅛@13¼c.; casting, 12⅞@13c.

Key West (Fla.) dispatches state that the Key West Electric Light Company has absorbed the Electric Light & Power Company in that city.

Industrial companies will pay out about $15,000,000 during June in dividends, as compared with $18,800,000 a year ago and $20,000,000 two years ago.

The Rochester (N. Y.) Railway Company has declared the regular quarterly dividend of 1¼ per cent. on its preferred stock, payable July 1 to holders of record June 20.

The directors of the Massachusetts Electric Companies have declared the regular semi-annual dividend of 2 per cent. on the preferred stock, payable July 1 to stock of record June 4.

The Edison Electric Illuminating Company of Brockton, Mass., has purchased the Whitman Light & Power Company and has petitioned the gas commission for its approval of the purchase.

The annual statement of the Montreal Light, Heat & Power Company showed gross earnings for the year of $2,589,446, expenses of $1,243,686, net revenue $1,345,759 and a surplus of $204,013.

The United Traction Company, Albany, N. Y., has floated $1,000,000 of the 4½ per cent. issue of gold bonds, which will be delivered to the purchasers to-day. About $960,000 was realized by the sale.

The Stromberg-Carlson Telephone Manufacturing Company decided at a special meeting of the stockholders to increase the capital stock of the company from $4,500,000 to $6,000,000. The factory in Chicago is to be closed, it was said, and all the manufacturing will be done at the factory of the company in Rochester, N. Y.

The plant of the Fort Wayne (Ind.) Electric Light & Power Company has been sold to a syndicate of Eastern capitalists, headed by Thomas Wanamaker, of Philadelphia, for about $300,000. It is said the same syndicate will purchase the Fort Wayne traction lines and the majority of the interurban connections, which have recently been merged under the name of the Fort Wayne & Wabash Valley Traction Company.

Stockholders of the General Electric Company are in receipt of a circular notice stating that stockholders of record June 15 will be entitled to subscribe for one new share for each ten then held. Subscriptions must be filed with the Farmers' Loan & Trust Company of New York or with the American Loan & Trust Company of Boston on or before 3 P.M. July 15, on which date the rights expire. Payments for subscriptions must be made on or before July 20. Certificates of stock will be issued as soon as possible thereafter.

The decision of Judges Grosscup and Jenkins, delivered in the United Circuit Court in Chicago Saturday morning, upholds the ninety-nine year franchise extension act of 1865, passed by the Illinois Legislature, under which the traction companies claim rights to their principal trunk lines until 1958 and 1960. The decision upheld the rights of the companies under all ordinances prior to 1875. It gives the traction companies on the three sides of Chicago rights to their most important trunk lines until 1958 and 1960. Rights of many of the minor lines will expire from time to time as the ordinance periods expire. The attorneys for the traction companies regard the decision as a signal victory.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Noon price May 31
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	143½
Metropolitan Street Railway	110
Metropolitan Securities	77⅜
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	47⅜
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	65¼
Philadelphia Traction	95¾
Union Traction, $17.50 paid	49¾
Boston.	
Boston Elevated, full paid	141
West End Street, com	90
do. do. do. pref	111
Chicago.	
City Railway	158
North Chicago	71
Union Traction, com	5½
do. do. pref	29
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	27
do. do. pref	60
Electric Lead Reduction	⅝
Electric Vehicle, com	6¼
do. do. pref	9½
Westinghouse, com	157
do. pref	235
General Electric	156
Boston.	
Edison Electric Illuminating	234¼
General Electric	155
Massachusetts Electric Companies, com	17¾
do. do. do. pref	70
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	145
National Carbon, com	29½
do. do. pref	102½
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	57½
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	124½
Western Telephone Company	8⅜
New England Telephone Company	121¾
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	..
Western Union Telegraph Company	87
Miscellaneous.	
Chicago Telephone Company	116
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

Electric Traction Progress.

The New York, New Haven & Hartford Railroad Company, we are informed, is planning to establish fast electric lines between New York and Boston, and the same company is about to install an electric line between Newport and Fall River to replace its steam road. A branch of the Boston & Maine system in Western Massachusetts has been forced to reduce its fares to an unprofitable minimum to meet the competition of the trolley line paralleling it. The forty new electric locomotives which are to be used on the New York Central's line between the New York City terminal and North White Plains will have double the horse power of the locomotives which haul the Empire State Express. They will be capable of a speed of 75 miles an hour.

* * *

Paris Electric Railway Disaster and Its Cost.

The finishing touches are now being put on the underground road in New York City, in order to have everything ready for the opening, about September 1, and it might be again in place to refer to the disaster which occurred in the Paris "underground" less than a year ago, and which has proved a costly matter for the Metropolitan Company, lessee of the line. One reason for our referring to the disaster at this time is that a report just issued by the Paris Metropolitan Company is an interesting document for many reasons, and one is that it shows what the calamity has cost the company in lost traffic, and what has been paid in compensation to injured parties and relatives of those who lost their lives. It is stated that compensation cost close upon $235,000 and loss of traffic amounted to over $160,000. The total income of the railway for the year was $3,530,000, and of this, under the terms of the concession granted by the Paris municipality, there has had to be handed over to the relief of the city rates the good round sum of $1,140,000. Then after deducting the working expenses, which were in the neighborhood of $1,500,000 (42 per cent. of the receipts), it was possible to give a dividend of about 6 per cent.

The year has been one of great moment to the Paris Company in the matter of capital expenditure upon the new power station, the conversion of the system of electrically working the trams to multiple unit, etc., and a great deal of new rolling stock is now in course of building. The lighting and traction supplies are now effected by entirely separate circuits, so that in future the stoppage of a train through failure of the power circuit will not mean that there will be no light available—a matter which it will be remembered was one of the chief causes of the panic at Paris. We understand that the undertaking so far completed represents about 22 miles out of the 26 miles which constitutes the first section. The new generating station, which is now almost ready, has a plant of about 20,000 HP.

* * *

The Telephone Industry.

The figures recently published by Director of the Census North, covering all the telephone systems of the United States for 1902, are very interesting, as from the data given the relative strength of the Bell system and of the Independents in that year may be computed.

The number of telephones in the United States in 1902 is stated to have been 2,315,297. The number of Bell instruments outstanding in that year was 3,150,320. As the Bell companies count transmitter and receiver as two instru-

ments, the number of Bell telephones was 1,575,160. The number of Independent telephones in 1902, therefore, was 740,137, or allowing for Bell telephones in Canada, probably about 750,000.

The gross earnings of all the telephone companies in the United States in 1902 were $86,825,526.

The number of "talks" in the United States is placed at 5,070,555,345. The amount of gross earnings indicates that the average cost per "talk" to the public was 1.7 cents.

The census figures bring out the very interesting fact that the average earnings of all the telephone companies per subscriber in 1902 was a little over $40. The average per subscriber for the Bell companies, however, was much higher, probably a little over $50.

Operating expenses of all the companies were 70.4 per cent. of gross. Including interest, the ratio was 74.4 per cent. Maintenance figures, which would be highly interesting, are not given in the report.

It is interesting to note the growth of the telephone industry since the close of the year 1902. The number of Bell telephones now outstanding is a little over 2,000,000 (4,000,000 instruments) and it is stated that the number of Independent telephones is now larger than the Bell. This would make a total of over 4,000,000 telephones now outstanding in the United States, compared with 2,315,297 at the close of 1902.

* * *

Rutherford on Radium.

A brief article appeared in these columns two weeks ago in reference to an interesting lecture on "Radiation and Emanation of Radium," delivered by Prof. E. Rutherford, of Montreal, before a distinguished body of scientists at a meeting of the Royal Institution in London.

Late mail advices state that the lecturer, after showing the power of radium to excite phosphorescence and to discharge a charged electroscope, described the properties of the three kinds of rays which it had been found to give off. Prof. Rutherford, we gather from the London *Times* report, said that in addition radium gave off an emanation which behaved like a gas and could be condensed by cold; it could also be secluded in the radium itself, and was liberated when the salt was dissolved in water. This emanation, though exceedingly minute in quantity, possessed three-quarters of the characteristic powers of radium and all its properties. Could we collect a cubic inch of the emanation, the tube containing it would probably melt, while a few pounds would supply enough energy to drive a ship across the Atlantic, though each of those pounds would require 70 tons of radium to supply it.

As to the process going on in the emission of the emanation, Prof. Rutherford advanced the theory that radium was continuously producing it, but that when produced, instead of remaining constant, it was continuously being changed into something else. He supposed that some atoms of the radium in some conditions became unstable; then there was an explosion. and particles of matter were shot off at great velocities. There was a series of such explosions, due to atomic, not molecular, changes, and resulting in the formation of a series of transition elements. A mass of radium left to itself, must, therefore, throw itself away. Probably in about 2,000 years its radio-activity would fall to half value, and after 50,000 years it would cease to exist. Therefore, said Prof. Rutherford, it was to be supposed, since radium was produced from minerals more than 50,000 years old, that it was being itself produced from something else, and was itself a transition element.

In the self-destruction of radium, he said, two things must be produced that were not radio-active—the *a* rays and the final product. Evidence pointed to the view that the *a* particle was helium. The lecturer mentioned that radium was distributed very widely over the earth, being present everywhere, but in very minute particles. He believed that the amount of radium present, uniformly distributed, would be sufficient to account for all the heat lost from the earth, and it would explain the temperature gradient as measured to-day.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The Canadian Electrical Association will hold its annual meeting at Hamilton, Ont., June 15 to 17.

The Brooklyn Rapid Transit Company is to have an order corps—that is, it has engaged 75 athletic young men to police its cars to check rowdyism and preserve order on rush days.

The Western alumni of Massachusetts Institute of Technology will go by special train to their great reunion at Boston this month and a visit to the electrical industries at Niagara Falls is to be given a day of the time en route.

The Board of Railroad Commissioners at Albany, N. Y., has issued the following order to the Interborough Rapid Transit Company as lessees of the elevated railroad systems in the Boroughs of Manhattan and the Bronx. "All cars operated on this company's system should be equipped with a modern fire extinguisher properly placed so as to be accessible in case of accident."

Electric lights in the upper berths of sleeping cars are an innovation made by the Chicago, Milwaukee & St. Paul Railroad Company.

Recent Experiments at the Massachusetts Agricultural College tend to show that atmospheric electricity acts as a stimulus to plants, and has much to do with their development and configuration. It was found during the experiments that at a distance of 30 feet from the ground the air, for about nine-tenths of the time, has a positive electric charge. The differences of potential between the earth and the air ranged from 75 volts negative to 300 volts positive. In thunderstorms the potential of the air frequently changes from positive to negative, and vegetation often becomes charged.

The Johannesburg Municipal Council is prepared to receive tenders for insulated cables and bare overhead conductors and certain accessories in connection with the municipal electric lighting and traction system projected in that South African city. The contract will be worth fully $500,000. Tenders must reach Mordey & Dawburn, 82 Victoria street, London, S. W., not later than July 4.

At the Boston meeting of the National Electric Light Association, which was held recently, an amendment to the constitution was adopted dividing the membership in five classes, as follows: Class A, member companies; entrance fee, $25; annual dues, companies in towns of less than 20,000 population, $10; 20,000 to 300,000, $25; over 300,000 population, $50. Class B, members, entrance fee $5 and annual dues $5. Class C, associate member companies, entrance fee $25 and annual dues, $20. Class D, associate members, entrance fee, $5 and annual dues, $5. Class E, honorary members, no entrance fee, annual dues, $4.

Mr. C. C. Tyler has resigned as superintendent of the works of the Westinghouse Electric & Manufacturing Company at East Pittsburg and has been appointed general superintendent of the Allis-Chalmers-Bullock interests.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

CIRCLE DIAGRAMS FOR KEEPING TRACK OF THE ECONOMICAL WORKING OF MEN AND APPARATUS.

Valuable information for a station manager to have clearly in mind is the arrangement of the different shifts of men in relation to the time of operating different machines and different kinds of apparatus, and it is only after a careful analysis that it will be possible for a manager to know accurately whether or not he is getting the maximum efficiency out of his employes by having their hours of working so arranged that each man is worked to his best ability at all times.

In order that such information may be clearly presented, circle diagrams may be constructed, which will be found to give a comprehensive, graphical statement of the actual conditions that exist. In preparing such diagrams faint concentric circles are drawn, the number of such circles depending upon the number of men or the number of machines, engines, boilers or generators under consideration, each man or each machine to be consid-

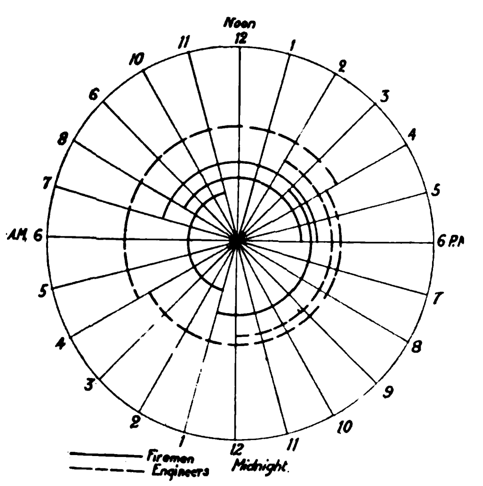


CHART A.

ered being given one circle. From the common center radial lines are drawn, 24 in number, representing 24 hours of the day. When several different classes of employes are to be considered, or when different kinds of apparatus or the time of operating different kinds of apparatus are to be shown on one diagram, different kinds of lines are made use of to distinguish one from the other.

Referring to accompanying Chart A, the solid lines represent firemen and the broken lines represent the time of working of the different engineers. For instance, starting at 1 o'clock in the morning, it will be seen that one fireman is on duty from 1 A.M until 11 A.M. At 8 A.M. another fireman starts to work and is on duty until 6 P.M. Another fireman starts working at 3 o'clock in the afternoon and ends his shift at 1 o'clock in the morning, while one coal passer, whose labor is charged to the boiler room as a generating cost, starts to work at 7 o'clock in the morning and works until 6 at night. In the same manner we have one engineer coming on duty at 2 o'clock P.M. and work-

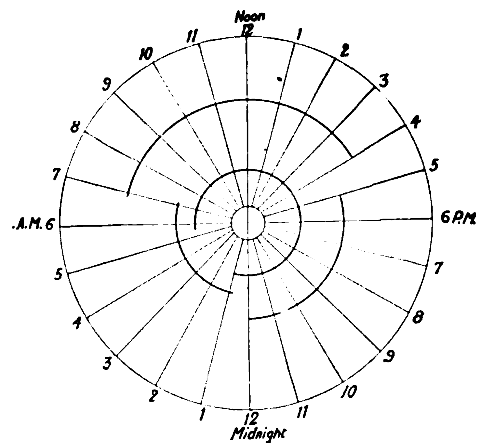


CHART B.

ing until midnight. Another works from 4 o'clock P.M. until 4 A.M., while a third works from 4 o'clock A. M. until 4. P.M.

Referring next to Chart B, the time of operation of different engines in use is shown. In the station under consideration the engines (four in number) are numbered consecutively from the center of the circle out. No. 1 engine starts at 5:30 A.M. and runs continuously until 1 o'clock the following morning; No. 2 runs from 12:45 A.M. until 7:30 A.M.; No. 3 from 5 P.M. to 12 midnight; No. 4 from 6:45 A.M. until 4 P.M.

Referring to Chart C, we find the time of operating the individual generators, the solid lines representing alternating current machines, the dotted lines the

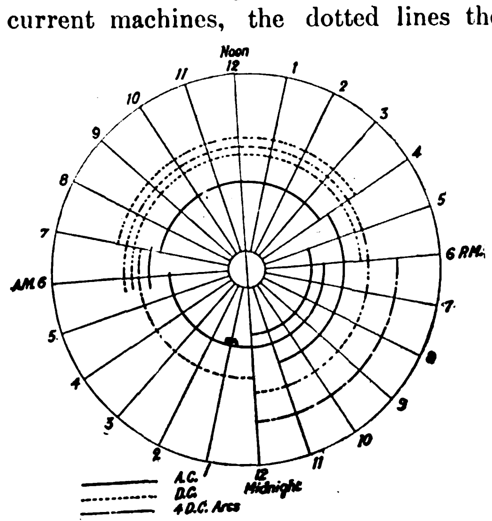


CHART C.

500-volt direct current machines and the dash-and-dot lines representing direct current arc machines.

Referring to Chart D, the time of operation of the three boilers is shown.

With the four charts before him the station manager can see at a glance for any hour in the day the number of men who are on duty at the plant, also the number of boilers, engines or generators that are operating, and unless a careful analysis has been made of the work that is required of the different men, it will very frequently be shown that much greater responsibility and much more work is thrown upon one shift than upon another.

Of course it is necessary in making the comparisons between the shifts to consider the output of the station at the hour under consideration, as well as the other work, such as cleaning and repairing, that is required of station men operating a small plant. This scheme also lends itself as a ready argument against increased help, which is sometimes unreasonably asked for, as it will show quite forcibly the duties required of the individual workmen. R. GRIEVES, Columbus, O.

RUNNING ALTERNATORS IN PARALLEL.

We are operating two 300-kw. two-phase, 2,000-volt alternators, direct-connected to vertical cross-compound marine

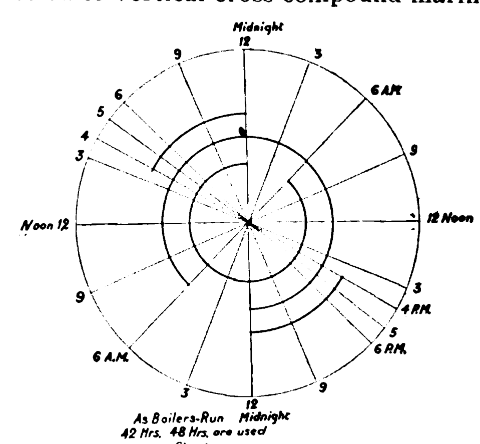


CHART D.

engines, running 189 revolutions per minute. The alternators are on the ends of an extended shaft, and each engine is fitted with a 13,000-pound flywheel between the alternator and the engine. The cranks are not at right angles nor opposite, but the high-pressure crank leads the low-pressure crank 150 degrees. This crank angle was adopted to give uniformity of rotation during each revolution. We found that notwithstanding this precaution, the heavy flywheel and high speed, there would, under certain conditions, be some variations in speed during each revolution. The machines would run in parallel sometimes without any surging; at other times the surging would be quite pronounced. The engines are

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

exact duplicates, and we found that when the alternators were thrown in parallel with the cranks of the two engines at the same point of the stroke we would have no difficulty. Since demonstrating this fact we have constantly run our engines under these conditions. To accomplish this we placed on each engine shaft a small wooden disk. A small contact, grounded through the shaft, was placed on this disk in a certain position relative

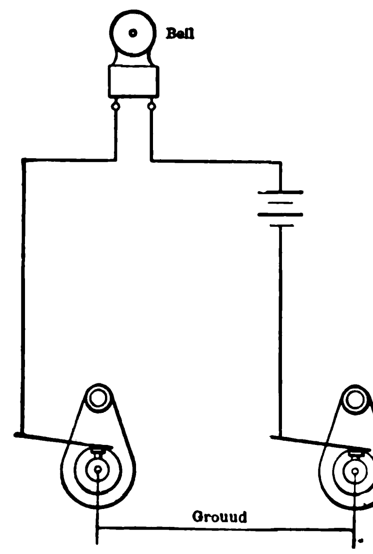


DIAGRAM SHOWING CONNECTIONS.

to the crank pin. A small brush, insulated from the ground, was placed in contact with this disk and two brushes placed in series with a battery and bell. As the contacts on the two engines passed into these brushes the circuit was established and the bell was rung. If the alternators are in synchronism at the same time the switch is closed the engines will then run together for a week at a time, each taking its proportion of the load without surging or disturbance on the electrical end.

A. GARTLEY, Honolulu, Hawaii.

RUNNING DYNAMOS AS MOTORS IN CASE OF BREAKDOWN OF ENGINE.

If an engine that drives both alternating and direct current machines breaks down, and it becomes necessary to use the direct current dynamos during the day and the single-phase alternator at night, it can be accomplished by disconnecting the connecting valve and rods of the engine and running the alternator as a motor, thus driving the direct current machine during the day, and at night reversing the condition by running the direct current generator as a motor, thus driving the alternator. A water resistance is used in starting the direct current machine to be run as a motor, the water resistance being cut out as soon at the machine is up to speed.

Before the alternator can be thrown on the circuit to be run as a motor it must be brought to synchronism with the other alternating current generators. This is done by running the direct current machine as a motor and adjusting its field resistance until synchronism is reached; then the alternator is thrown in and will run as a motor, while the direct current machine is switched out and run as a generator. A synchronizer can be improvised for the purpose by the use of two line transformers by connecting the primary of the one to the bus bar and the primary of the other to the terminals of the alternator that is to be run as a motor. The secondaries are connected in series through two lamps.

WM. GALLAHER, St. Louis, Mo.

REMOTE CONTROL OF ELECTRICAL APPARATUS.*

BY WILLIAM H. COLE.

The object in presenting this paper to this association is to bring out and stimulate interest in various methods of controlling apparatus used in the regulation, conversion and distribution of electricity. It will deal more particularly with methods, both proposed and actually used, for the control of constant-current apparatus where cost and convenience, or both, require that such apparatus be placed at points remote from the generating or operating station.

Of course it is possible to locate all such apparatus in the operating station under the manual control of the operators, where all operations incident to the starting and stopping may be performed by the attendants, and where the necessary remedies may be applied in cases of trouble. This course, looked at from an engineering standpoint, may be the best to pursue, but for commercial reasons it must at times be departed from.

Generally speaking, in laying out a system of distribution, simplicity is aimed at, and we try to reduce the number of conductors in our trunk lines to the smallest possible number consistent with the demand for continuous service. One of the main objects in locating constant-current apparatus in sub-stations is to produce this result, and in so doing we not only do away with the maintenance of a large number of high-tension, low-current wires, but provide room for duplicate feeders to the sub-station.

While locating such apparatus in substations relieves us of the burden of maintaining a system of distribution where all circuits start from the generating or operating station, we must not lose sight of the fact that such location presents an opportunity for a better division of secondary circuits with a corresponding reduction in potential. Supposing that for economic reasons it is considered advisable to locate apparatus of this nature in a sub-station situated at some distance from the source of supply, this question naturally arises: "What method of control shall be used?" As for several reasons it is not desirable to switch constant-current apparatus on to a

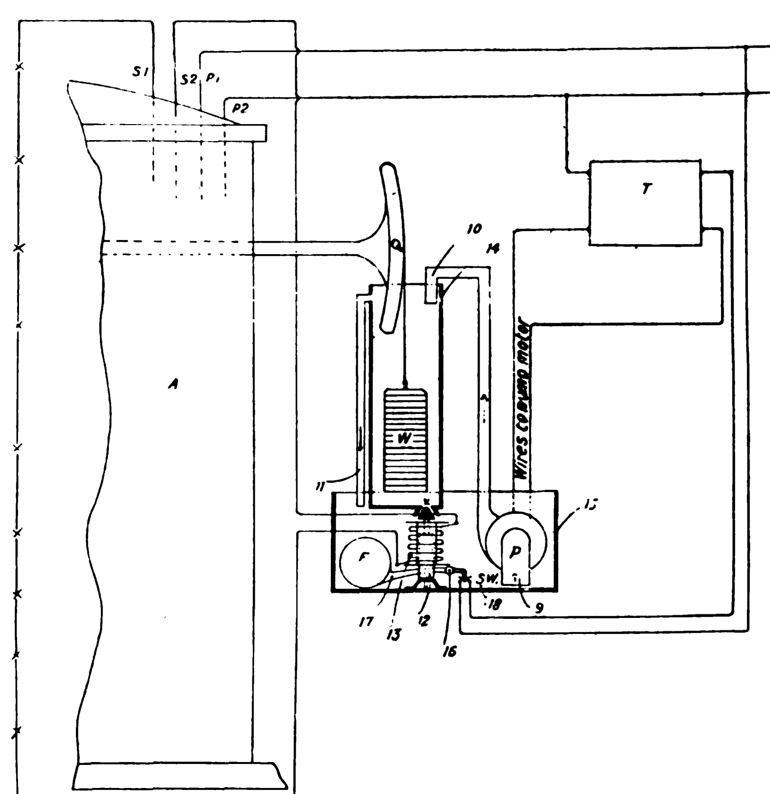


FIG. 1.

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24, 25, 26 and 27, 1904.

system unless the relative position of the fixed and movable coils is such that nothing greater than the normal current may flow—particularly if incandescent lighting forms a part of the load—the question naturally suggests but a choice between two methods, namely, manual or automatic control.

Manual control suggests an operator on duty at starting time and possibly all the time apparatus is in operation.

Automatic control, to be effective, must produce substantially the same results as manual control from the time the current is switched on to the apparatus until it is switched off.

Taking up the most important application of remote control, I will describe a system of controlling constant-current transformers connected to circuits of arc or incandescent lamps arranged in single or multi-circuits.

In applying this method we first find it necessary to use a special counterweight whose weight and volume bear a certain relation to each other, which necessity I think will be obvious after a description is given of the workings of the system.

Referring to the diagrammatical representation of a constant-current transformer of the two-coil type, Fig. 1, the means for controlling and the operation is as follows:

A represents a partial view of the casing inclosing the apparatus to be controlled; Q, an adjustable arc carrying the adjustable counterweight W; p1 and p2 represent the primary mains, and s1 and s2 the secondary mains leading to the lamp circuit; 14 and 15 represent two tanks adapted to contain oil or some other suitable fluid.

P represents a pump of any suitable construction driven by a motor (not shown in sketch) supplied with current through the secondary leads from the small transformer T. The suction is represented by 9, and 10 is the discharge of the pump P. F is a float responsive to the variation of level of the liquid in the tank 15, and is carried by the arm or lever 17, pivoted at 16, and operates the switch 18.

Connected in series with the lamp circuit is a solenoid 13 controlling the vertical movement of the core 12, which in turn operates the valve V in the lower end of the tank 14.

It is, of course, to be understood that this sketch refers to apparatus in which a reduction of the weight W normally produces an increase of current in the work circuit.

In adjusting a constant current transformer or reactive coil controlled by this method it is necessary to make the counterweight W sufficiently heavy to slightly more than balance the weight of the moving parts of the apparatus to be controlled; or, in other words, the weight must always take the lowest or no-load position with no current on. This adjustment is of course made with the weight floating in air.

The next adjustment is to change the volume of W without changing its weight, so that it will regulate for the current desired. This adjustment is made with the weight immersed in oil.

It is evident that after these adjustments are made the weight and volume of W is such that the transformer or coil will regulate for constant current with the tank 14 full of oil, and will assume the no-load position when tank 14 is empty.

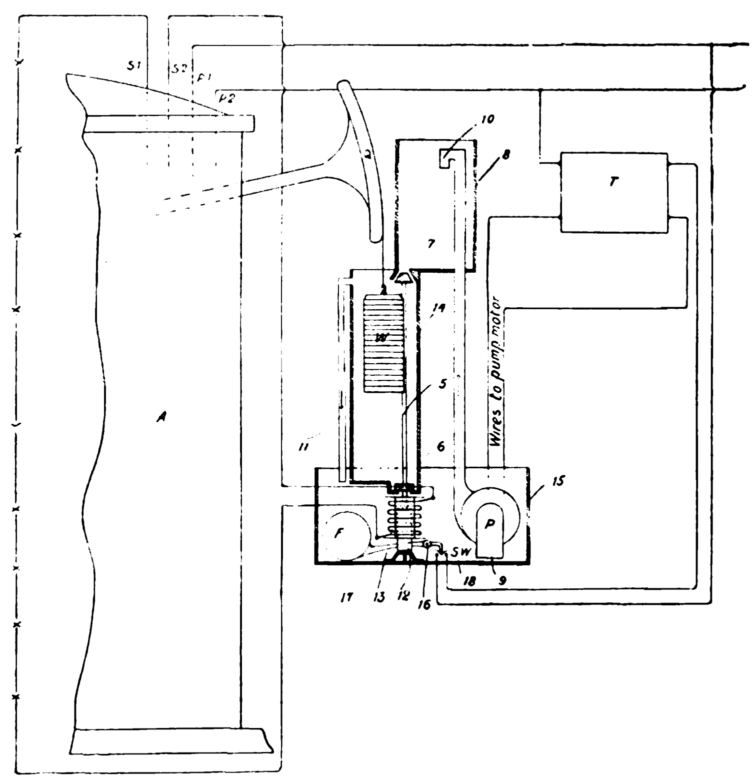


Fig. 2.

At starting tank 14 is empty, valve V is open, switch 18 is closed, and tank 15 is filled with oil to a suitable height.

If circuit containing translating devices is closed the solenoid 13 is energized, core 12 is drawn up, closing valve V. Switch 18 being already closed, transformer T supplies current to the motor driving pump P, which draws oil from tank 15 and forces it into tank 14. This continues until the level of the oil in tank 15 is brought low enough to operate float F and switch 18, which opens the primary of transformer T, causing the motor and pump to stop. At this point the oil has reached a level in tank 14 sufficiently high to entirely immerse W through its entire range of travel. W has meanwhile gradually taken a position depending upon its adjustment and the load and regulates for constant current.

When shutting down the lamp circuit, the current is switched off from the apparatus, and the solenoid 13 is immediately de-energized, allowing valve V to open by gravity, which allows the oil to flow into tank 15. As is very readily seen, this action causes W gradually to take its no-load position, and switch 18 closes, thus leaving apparatus prepared for the next switching on of current. It will be observed, of course, that in case valve V should leak during the operation of apparatus, the float switch would automatically close and oil would be pumped back into tank 14 to supply leakage.

This system has also been worked out for the control of transformers of the large sizes where more than one secondary coil, balanced one against the other, is used; but it is not deemed necessary to explain it here, as the same general principles apply.

A sketch showing the arrangement of tanks and valves necessary for the control of these large transformers is herewith shown, Fig. 2, and from it the operation may be deduced.

In connection with these methods of remote control it is desirable and profitable to use some method of disconnecting circuits that may for any reason accidentally open.

By using automatic absolute series cutouts we not only provide means for keeping all lamps burning that are not on the faulty circuit, but by absolutely discon-

necting the faulty circuit or loop from the rest of the secondary system we remove a source of considerable danger to the public from fallen wires. This cut-out is arranged to be thrown in cases of open circuits by means of a spring and trip, which trip is operated by a solenoid or magnet. This magnet or solenoid, as the case may be, is connected to the secondary of a small transformer or compensator whose primary is connected in shunt to the loop or circuit to be disconnected in case of accident. The principle upon which the operation of this cut-out depends is as follows: During the normal operation of the system the potential impressed upon the primary of the transformer or compensator is proportional to the number of lamps burning on the loop beyond the cut-out. The core or armature of the solenoid or magnet is so adjusted that the normal secondary potential of the transformer or compensator is not sufficient to trip the cut-out.

If, however, the loop or circuit should open, there is immediately impressed upon the terminals of the small transformer the full potential of the constant-current transformer secondary. This same ratio of increase also appears at the terminals of the tripping coil, which is so adjusted that it immediately trips the cut-out. This cuts out the open loop and re-establishes the continuity of the circuit through the remaining lamps.

It is obvious, of course, that the field of usefulness of this device is not limited to indoor or sub-station use. It may be, in certain cases, desirable to cut in reactance or counter electromotive force in place of the disconnected circuit, which may readily be accomplished with the same apparatus.

Of course it is well known that remote control of various kinds of apparatus has been accomplished by the use of auxiliary wires operating electro-magnetic switches or other electro-mechanical devices that by means of levers, weights, etc., may be made to perform certain duties.

It is fully appreciated by the writer that remote control of electrical apparatus to be commercially successful must be as simple mechanically as possible, and must require no auxiliary wires from the operating station, clock-work devices, time switches, or kindred apparatus.

Oil is an agent for producing the necessary changes in the effective weight of the counterbalances, being a flexible medium and easily handled by a free-acting pump, tends to give a reliability to the performance of the apparatus which would not be possessed by any mechanical device calculated to produce the same results.

The development of a successful automatic series cut-out supplies a growing want for a device of this character, more particularly felt since the advent of the high tension series alternating system of lighting.

The system described in the foregoing paper is the product of considerable thought and experiment, and is calculated to produce the desired results with the minimum of mechanical and electrical complexity.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE IV.

BY W. H. WAKEMAN.

Formula No. 13, for steel boilers:

$$\frac{4{,}480\ t\ S}{d} = p.$$

t = thickness of plate in inches.
S = tensile strength of plate in tons.
d = diameter in inches.
p = bursting pressure in pounds.

The author of this assumes that the tensile strength is 28 tons per square inch of sectional area, and for steel boilers with double riveted lap joints the joints have .80 of the strength of solid plate, therefore the value of S is 28 × .80 = 22.4 tons. Applying this to the boiler taken for comparison with plates .5 inch thick and a diameter of 72 inches gives the following bursting pressure:

$$\frac{4{,}480 \times .5 \times 22.4}{72} = 700 \text{ pounds.}$$

Adopting 5 as a factor of safety shows that the safe working pressure is 140 pounds.

Formula No. 14, for iron boilers:

$$\frac{4{,}480\ t\ S}{d} = p.$$

This is the same as for steel boilers, so far as the constant and the letters are concerned, but the application of it gives a very different result, as the tensile strength of iron plate is taken at 24 tons and the efficiency of riveted joint is .70 of the strength of solid plate. This reduces the value of S to 16.8 and lowers the bursting pressure accordingly.

$$\frac{4{,}480 \times .5 \times 16.8}{72} = 522 \text{ pounds.}$$

522 ÷ 5 = 104 pounds safe working pressure.

The next formula presented is an ingenious device, of much interest to students of this important subject.

Formula No. 15, for steel boilers:

$$\frac{X\ t\ S}{D} = P.$$

X = a factor which is varied to suit the kind of riveted joint used. Its value is given in the following table:

For solid plate............ X = .5
For double riveted joint with drilled holes............ X = .4
For double riveted joint with punched holes........... X = .35
For single riveted joint with drilled holes............ X = .3
For single riveted joint with punched holes........... X = .25

t = thickness of plate.
S = tensile strength of plate.
D = diameter of shell.
P = safe working pressure.

The apparent absence of a factor of safety is somewhat surprising, but it is contained in the value of X as given for different conditions.

The casual observer of such a formula usually decides that it is defective, hence of no value, because it fixes arbitrarily the value of the various joints, but this is a mistake, because thorough investigation shows that each joint is described in detail for all conditions found in stationary practice. The results of rules given are noted in a comprehensive table, which I cannot reproduce here, but the rule on which this table is based is of interest and value.

This rule states that the shearing strength of rivets and the tensile strength of plate are the same, therefore the area of rivets in a section of joint must equal the sectional area of plate between the rivet holes.

This conclusion does not agree with all other authorities on this subject, but some of the many experiments made along this line warrants the rule, consequently it is worthy of notice and will be considered accordingly. The table does not agree exactly with the rule, and the fact that this is impossible will be apparent at once when the value of X is given at .4 for drilled and .35 for punched holes. The rule is followed approximately, however, therefore is as nearly consistent as can be expected in such cases. Furthermore it includes the statement that the distance between rivets in the direction of the joint (which is usually called pitch) should be double the distance between the two rows of rivets, thus causing the rivets in the two rows to stand at right angles to each other, as illustrated in Fig. 8.

It is also stated that in order to meet the requirements of this rule the diagonal distance between rivets in a double riveted

seam, or from 2 to 3 in Fig. 8, must equal the pitch in a single riveted seam in the same plate. The distance from 4 to 5 is one-half the pitch of rivets.

When a boiler is built according to these specifications the strength of shell, provided it is made of steel .5 inch thick with a tensile strength of 60,000 pounds and is 72 inches in diameter, may be calculated by Formula No. 15:

$$\frac{.35 \times .5 \times 60{,}000}{72} = 145.83 \text{ pounds.}$$

The three following formulas are not given for determining the safe pressure of boilers, but are of interest in this connection. Meaning of the letters has already been explained:

No. 16. $$\frac{X\,t\,S}{P} = D.$$

No. 17. $$\frac{D\,P}{X\,S} = t.$$

No. 18. $$\frac{D\,P}{X\,t} = S.$$

When applied they give consistent results.

No. 16. $$\frac{.35 \times .5 \times 60{,}000}{145.83} = 72 \text{ inches.}$$

No. 17. $$\frac{72 \times 145.83}{.35 \times 60{,}000} = .5 \text{ inch.}$$

No. 18. $$\frac{72 \times 145.83}{.35 \times .5} = 60.000 \text{ pounds.}$$

In these applications the weaker form of double riveted joint is taken in order to be on the safe side.

The bursting pressure is claimed to be four times the safe working pressure, or in other words, the factor of safety based on the strength of riveted joint is 4 in these calculations.

The only difference between steel and iron boilers provided for by the four preceding formulas is in variation of the tensile strength, but that is sufficient.

Formula No. 19, for iron boilers:

$$\frac{X\,t\,S}{D} = P.$$

Assuming the tensile strength of iron plates to be 50,000 pounds, its application results as follows:

$$\frac{.35 \times .5 \times 50{,}000}{72} = 121.5 \text{ pounds.}$$

The constant .35 is used for both steel and iron boilers, as this is suitable for double riveted seams, and single riveted seams should never be used on these boilers except on the curvelinear seams, as the strain on them is very much less than for the longitudinal seams of a tubular, flue or plain cylinder boiler.

The next formula presents peculiar features that are of interest:

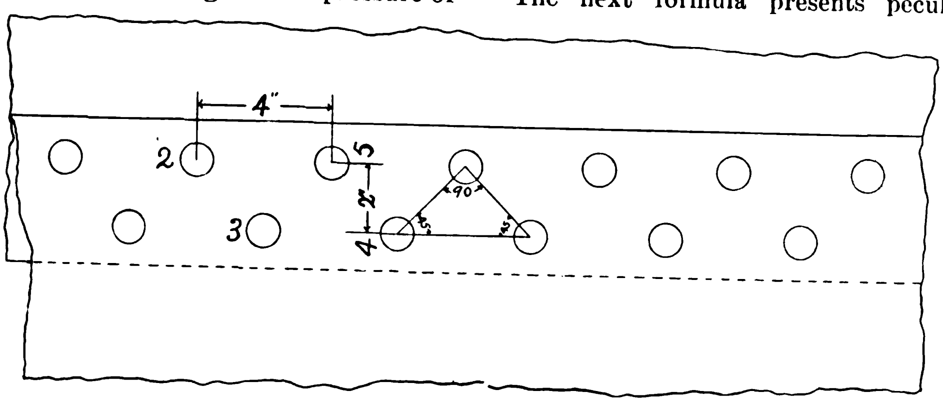


Fig. 8.

Formula No. 20, for iron boilers:

$$\frac{2\,t\,C}{d} = P.$$

t = thickness of plate.

C = 7,800 for best plates, 6,200 for medium and 3,700 for ordinary, assuming the joint to be double riveted.

d = diameter of boiler.

P = safe working pressure.

This formula is based on a factor of safety of 9 on the solid plate, but when the efficiency of joint is taken into consideration it is less accordingly. If the latter is .75 then the real factor of safety is $9 \times .75 = 6.75$.

Applying this gives the following result, using 6,200 as the value of C:

$$\frac{2 \times .5 \times 6{,}200}{72} = 86 \text{ pounds, which}$$

is a very conservative estimate of the safe pressure, as the factor of safety is large.

Wind Power for Electric Stations.

The problem of wind power for electric stations has been studied for several years by Professor La Cour, in the interest of the Danish Government. To overcome the difficulty of irregular speed, the motor is provided with an intermediate shaft in connection with a balance, and the belt from the windmill is led vertically on the disk of this shaft, the pressure of the latter being regulated by the balance bearing convenient counterweights. Through this device the belt slides on the disk as soon as the load exceeds a given maximum. A wind power plant, supplying about 50 amperes of current at 110 volts, has been in operation a year at Askov, Denmark, and feeds about 450 incandescent lamps. It has given excellent results, with little attention, calms of several days being bridged over by a reserve of petroleum motors.

REPORT OF THE COMMITTEE ON PROGRESS.*

BY T. COMMERFORD MARTIN.

(*Concluded from page 301.*)

OTHER FOREIGN COMPARISONS.

Anticipating to some extent other portions of this report, note may be made here of the interesting observations on European conditions presented last September before the Association of Edison Illuminating Companies by Mr. Arthur Williams. In regard to London, he remarked that as to arc lighting the prices paid by the municipality vary from $110 to $150 annually for an arc lamp of about the same size as our lamp rated at 2,000 cp. The practice is to place the lamps much nearer together, in many instances, averaging not more than 100 feet apart. The city furnishes the posts and shades; the companies provide all else, giving the lamps the usual attention. Inclosed arc lamps have made very little headway; and for the most part they have not given satisfaction to the users. The reason the English engineers adhere so devotedly to the open-arc lamps is that in London and other English and European cities the price of labor and carbons is low, while the cost of current is high—the reverse being true in our American cities. There are 36 companies or vestries in London operating electric lighting plants. The aggregate of the installations was hardly more than 5,000 hp., and the arc lamps were something less than that number.

It appears that 13 of the companies or vestries use Wright demand meters, not exclusively, but in conjunction with their rates. The companies using these meters control about 45 per cent. of the total installation.

A novel kind of rate was that adopted by the St. James and Pall Mall Company, in London, for long-hour, usually "hidden" lighting. By hidden is meant the lighting of hotel, apartment-house and club cellars, kitchens and servants' quarters, shops below the sidewalk level, basements and the public-comfort con-

*Abstract of report read before the National Electric Light Association at its 27th Convention, held at Boston, Mass., May 24-27, 1904.

veniences, which the city of London has liberally provided at the large intersections. The retail rates of this company were 12 cents a kw.-hour for the first 4,000 kw.-hours of annual use and 8 cents for all over, with a discount of 8 per cent. on all bills paid quickly—say within 30 days. To meet the competition of gas in the places mentioned, the company adopted a new schedule, under which all "below street level" lighting is supplied at exactly half the usual rates. That is to say, the first 4,000 kw.-hours are charged for at 6 cents instead of 12 cents, and the remainder at 4 cents instead of 8 cents—and the additional discount of 8 per cent. is also allowed. If the consumer's premises are half above and half below the street level, he is given the benefit of a liberal interpretation of the schedule, and charged altogether at the low rates. Separate meters are provided where necessary to separate other parts of the premises supplied at the higher rates. English, or perhaps London, views regarding credit are interesting. Payment within 30 days is considered cash; 9 months are not unusual. It may be of interest to know that one company charged 12 cents a kw.-hour for service at 100 volts and 10 cents where taken at 200 volts.

In Paris, Mr. Williams found that, as in London, the use of arc lamps for street lighting had increased, in the last two years, the greatest service being in the center of the city. Open lamps are used, again because of the low cost of carbons and labor and the high cost of current. The lamps are spaced apart an average not exceeding 100 feet; in some places the distances are much less. There seems to be no desire on the part of the city officials to utilize the private-window lighting for the illumination of the thoroughfares; and this is well, for there is little, if any, display lighting of that order that is worth mentioning. The companies supplying electric current are limited in their franchise to a maximum price equalling 30 cents a kw.-hour, but there is no limitation upon the extent to which this price may be reduced. The average price obtained is about 22 cents a kw.-hour. Companies making electric current inside the city's walls pay a tax of 5 per cent. on their gross income, while those that generate outside the walls, thus avoiding the octroi duty paid upon coal brought within the fortifications, pay 1 per cent. additional, or 6 per cent. The cost of municipal arc lighting, where supplied by private companies, is at the rate of $240 annually, but the annual expenditure is in many cases lessened through the disconnection of the lamps at midnight or shortly thereafter. As the companies are taxed upon their gross income this figure is reduced 5 per cent. or 6 per cent., as the case may be, so that the net cost is not far from $225 a lamp annually. At the end of 1901 the five private companies and the municipal plant of Paris had 68,267 kw. of installation, equalling 1,365,340 sixteen-candle equipments. The capacity of all the stations was 38,000 kw., or 56 per cent. of the installations; 27,322,000 kw.-hours were sold, the consumption averaging about 400 hours per unit of installation.

RATIO OF CURRENT COST AND CONSTRUCTION.

American private companies will note with interest the rates quoted previously for electric lighting and would be glad to secure such prices for their arcs. One of the best things done by this association last year was to publish a bulletin of American rates for light and power. I may quote here some of the data for reference, and for comparison. Berlin, for example, has this year current at 10 cents per unit for lighting and power purposes down to a minimum of 3.5 cents. In this country a most conspicuous feature is the tendency to favor the consumer by lower prices. The old basis of 20 cents per unit with small discounts, or approximately one cent per lamp-hour, is now seldom maintained, and when used at all is generally modified by discounts for prompt payment large enough to form a substantial reduction. Common prices are 15, 17 and 18 cents per unit, with liberal discounts. Many plants in the regions of cheap coal have come to even lower prices, as have water-power plants generally, and the number of plants charging as low as 10 cents per unit is surprising. For power service, 10 cents with large discounts is rarely exceeded, while many plants sell at 5, 6 and 8 cents, with ample discounts to the larger consumers. The lowest figure for power noted is 1 cent per unit for consumers taking 300 hp. or more, but sliding discounts bringing the price down to 2 or 3 cents per unit are common in case of water-power plants or those in regions of cheap fuel.

Mr. W. F. White, a well-known central station manager, in a recent comment said that "the field for the sale of electrical energy is comparatively unexploited. Its sale for general power purposes has only begun. In not a single large city of the United States have the possibilities of the industrial power business been fully developed, much less exhausted. In many of our best cities to-day the gross receipts from the sale of electrical energy for all purposes do not exceed $1 or $1.50 or $2 per capita per annum. Such volumes of business can be multiplied three, four or five fold." This is undeniably true, and is as significant for the manufacturer of apparatus as for the purveyor of current. So far as I am acquainted with central station work in our large cities, there is not a company that is free from anxiety as to how each summer it shall provide plant enough to carry the peak of its load the coming Christmas. As to steady consumption, every company has its own yard-stick data. A recent analysis of the output of a company operating 10 plants showed that with 4,904 customers, and 214,934 lights connected, there was an average current used of 27.28 kw.-hours per 16 cp. lamp.

THE NERNST LAMP.

During the last year the Nernst lamp appears to have made steady progress in a field that was already pretty well occupied by competitors. While, of course, there have been some minor improvments made in the mechanical details of the lamp tending toward a simpler and more rugged construction, the commercial success attained may be attributed largely to the fact that the local lighting interests of the country are coming gradually to appreciate the inherent advantages that the lamp undeniably has. In its earlier history or stages, the lamp had to make its way on its merits in a pre-empted domain, and that it has marked out its own sphere of occupancy repeats once again the record of every new invention of real utility. It is worthy of note that since I reported last, the Nernst Lamp Company in this country, desiring to establish a closer relationship between the manufacturer and user and in a measure control the operating conditions, has instituted the policy of utilizing the central station as a medium for effecting the sale of its product. This policy embodied in a "central station contract" is of interest and is in effect in St. Louis; Detroit; Appleton, Racine, Milwaukee; Madison, Wis.; St. Paul; Denver; San Antonio, Tex.; Long Branch, N. J.; Lincoln, Neb.; Harrisburg, Pa., Durham, N. C.; Winston-Salem, N. C.; Waverly, N. Y., Sayre, Pa.; Liberty, N. Y.; Reidsville, N. C.; Hoopeston, Ill.; Sycamore, Ill.; Quincy, Ill.; Alliance, Neb.; Sparta, Wis.; Hartford, Conn.; Unionville, Conn.; Sheboygan, Wis.; Lapeer, Mich.; Raleigh, N. C. As illustrative of its vogue, note may be made of the fact that the Nernst lamp is to be used for lighting the entire fine arts exhibit at the St. Louis Exposition.

So much for the strictly commercial respects of this new illuminant in this country. Abroad, the lamp seems to have made considerable headway, and the direct current form to be used as well as the alternating current style still used exclusively here. It is stated that those in use in Buckingham Palace, a royal residence in London, have proved quite satisfactory, reducing the current consumption by about 50 per cent., according to a paper read before the Municipal Electrical Association of England. With reference to the experience of the electrical engineer at Gravesend, England, the life of such lamps was also quoted. He installed 48 Nernst lamps of 0.5 ampere in place of incandescent gas burners, and the average life at the end of three months was 960 hours. The 960 hours do not represent the true life, as at the expiration of the three months there were 48 burners alive. From a report of another engineer, who installed three sets of six lamps each, it appears that the average life of one set was 836 hours, of another 575 hours, and of the third 652 hours.

At the meeting of the Iowa Electrical Association in April of this year, experiences with Nernst lamps were reported by several members. Mr. Gardner, of Mount Vernon, Iowa, reported very satisfactory results from one year of operation. The quality of light made it a good lamp in drygoods stores, and his customers liked it, both on account of the quality and the amount of light obtained for the money. The lamp required more attention than incandescent lamps. Mr. Green reported that his company was supplying current heating 500 and 600 glowers. The maintenance of lamps was about .6 cent per kw.-hour supplied to the lamp. Mr. Burt stated that in a Catholic church three six-glower lamps had been installed with such good results that delegations from other Catholic churches in the State had come to inspect the lighting. He had found the Nernst lamp a good thing with which to compete with the gas-arc, upon which the repairs were by no means small. His company, which owns a gas plant, charged $1 per month maintenance on one Humphrey gas-arc installed for a customer, and 50 cents for each additional arc. The greatest difficulty experienced was the burning out of the heater, usually due to neglect on the part of a customer to turn off the lamp when the glowers were burned out. Mr. Green stated that he was installing three-glower Nernst lamps to do the same work as four-burner Humphrey gas-arcs.

(*To be continued.*)

ELECTRIC LIGHT AND POWER PLANTS IN CONNECTION WITH ICE PLANTS.*

BY C. L. WAKEFIELD.

I offer an apology, to begin with, for approaching a subject of this kind with so little data, and practically all that I am about to say is based upon my own experience. Correspondence with about 50 plants, supposed to be operating ice and power plants together, resulted in showing that very few were actually doing so, and these, with three exceptions, without purpose—by accident, as it were. It is strange how many operate by accident, which proves how long-suffering is the "Great Architect." I recommend that the association try to have careful data kept for the coming year on this subject and have the results tabulated.

It can be accepted as a general proposition that anywhere south of that much-heard-of Mason and Dixon's line, electric lighting and power plants can be operated in combination with ice-making plants, where steam is the motive power, advantageously to both industries.

To many members of this association the art of making ice is probably entirely unknown; therefore, I beg your indulgence to state briefly: Ice is made by the rarefaction of gases or the evaporation of liquids in inclosed pipes, the heat effort necessary to do this work being taken from a surrounding medium, a non-congealing heat conductor, which in turn gets its heat from water, in cans or on plates, which it is desired to have frozen.

Distilled water is generally used for making ice, for the sake of purity and clearness of appearance; more especially the latter. This water is distilled from the steam exhausted from the ammonia pumps where the compressor system is used, and from separate distilling apparatus where the absorption process is used. Nearly all modern ammonia pumps will freeze 20 per cent. more water than their exhaust will furnish, and as the absorption process requires a separate distilling apparatus all the water that can be obtained from other sources is an advantage easily seen.

Distilled water must be kept by itself, as any mixture, however slight, with undistilled water will cloud the ice. It is also true that the water must be kept as free of air as possible. Nevertheless, it is practicable to take distilled water from a pipe condenser maintaining a vacuum at the same time.

*Paper read before the National Electric Light Association at its 27th Convention, held at Boston, Mass., May 24-27, 1904.

As to the question of labor: We opened a 300 kw. alternating current plant with the addition of one oiler and one fireman more than our regular force. We were operating this in connection with a 100 ton ice-making plant of a compressor and can system.

It is, of course, not good business to start such industries except where a market is already prepared or on ground that will yield to the plow, but with these conditions in the right shape, the advantages of the combination suggested are seen to be: First—The employment of labor for the year around that would otherwise have little to do, but still must be kept on hand. Second—A saving in the use of water that would otherwise go to waste. Third—A saving in the condensation in steam pipes and headers, which can be almost constantly employed. Fourth—The steady load on boilers, with the advantages of which you are all familiar; and upon this point the following is true:

In the warmer climates all business houses close early and people sit much out of doors in the summer time. The load on the electric machines, therefore, is very light; in our experience not much over half in summer what it is in winter, and not more than one-fourth in quantity and length of time. When the load on the ice plant increases as the summer advances, and decreases as the winter comes on, it is also practicable to slow down or close down the ice machines for a short period during the peak of the load on the electric plant.

I believe it entirely practicable to operate the ammonia and water pumps electrically so as to give a more even load on the generators.

I have found it much easier to get an engineer posted in electricity than one who could operate an ice plant. Electricity seems to present so many possibilities to the imagination that men seek to follow that trade, both as to theory and practice, who should be writing "fairy stories" on other subjects. I present this as one of the minor difficulties in the way of these combinations.

The fuel cost per ton of ice has a wide range; from 350 pounds to 700 pounds of coal being necessary, depending, of course, upon the calorific value of the fuel and the manner of its use.

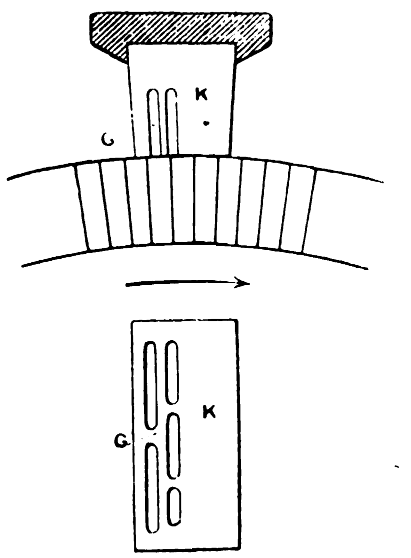
The value of cold-storage plants and the necessity for their existence in the South are being slowly grasped, and these offer a still larger field for growth and additions to both ice and electric plants.

The only hope I have in presenting this short paper is that it may stimulate more

patient investigators than myself to examine this question, bringing to the work a scientific knowledge of both industries, which I do not possess.

NEW CARBON BRUSH.

Mr. Gisbert Kapp has just patented a new type of carbon brush, the details of which can be seen in the following illustration, which we take, says the *Electrical Engineer*, London, from the *Elektrotechnische Zeitschrift*. The brush is to assist



in a sparkless commutation in direct current machines. The reversal of current in the conductors, which are connected to the commutator's sections, is influenced largely by the resistance of the brush contact. With an ordinary brush this resistance increases rapidly, starting from a very low value, and becoming infinite at the moment when the section of the commutator leaves the brush. Mr. Kapp gives a special form to the brush, which increases the time during which the variation of this resistance is produced. By this means he is able either to avoid the use of a reversing field, or to employ a much more feeble one. The brush consists of a solid part, K, which serves to collect current, and a second part, G, which is honeycombed in the manner shown. The diminution of the surface of contact thus obtained serves to augment the contact resistance at this point, which effect is required.

Electro-Mechanical Coupling.

A note presented to the French Academy recently describes an "electro-mechanical" coupling which allows a continuous change of speed from zero to maximum speed, and which is specially suitable when the prime mover is near the axle to be driven. It consists of a combination of the prime mover with two dynamos, one running as generator, the other as motor, and both being of a much smaller capacity than the prime mover, say ⅛ or ¼. The prime mover transmits always a certain part of its power directly to the main axle to be driven while the rest of its power is absorbed by the electrical machine which runs as generator. A train of epicyclic gearing is used in such a way that the main axle is acted upon simultaneously by both the prime mover and the dynamo which runs as motor. These two machines are separate, and may consequently have different speeds. For instance, an epicyclic gearing may be composed of a central toothed wheel and an external wheel with inside teeth, with toothed wheels between the two. The axles of the latter are fixed on a support. The desired result is obtained by connecting each of the three parts (internal wheel, external wheel and support of the middle wheels) with one of the three axles—that of the prime mover, that of the electric motor, and the main shaft respectively.

DISCOVERY AND INVENTION.

Practical men do not need to be told that there is an immense difference between the two words forming the subject of this article, but this fact is not sufficiently recognized by those who are prone to call themselves inventors. There are many problems in connection with mechanical science, and in connection with industrial undertakings that can be very readily solved by those familiar with the subject, but the fact that they are not solved is solely due to the experience which has possibly been acquired in connection with experiments that have demonstrated that the resulting advantages were not worth the effort, or to use a common phrase, "the game was not worth the candle." There are, however, to be found men with just sufficient mechanical knowledge to make them acquainted with defects connected with many mechanical engineering devices, and who heedlessly rush to inexperienced patent agents for the purpose of having their ideas protected that are to solve the difficulties they imagine no other person can so solve. Thus, as an illustration, it is well known that sea water contains gold, but it is generally conceded that at the present time efforts to extract such in anything like commercial quantities would be most unprofitable, and although the discovery of a method might be duly chronicled and recorded in the Patent Office, the practical result of the invention would be to extract gold from the pocket of the inventor rather than from the material upon which he would be working.

Tidal power machines are quite within the range of that which is practical to the engineer, and there is no difficulty whatever in constructing machines that will efficiently work under the incoming and outgoing flow of the tide, but that such machines can be made anything like commercially satisfactory has up to the present been considered an impossible or useless task to undertake; notwithstanding this, there are to be found every year fresh aspirants for fame, seeking to teach engineers how to produce tidal-power actuated machines. To reduce friction by introducing ball and roller bearings in connection with axles of railway stock is undoubtedly a very desirable object, and no great difficulty need attend those who propose to make such bearings as will yield to the inequalities of the wearing surface of the rail and the vibrations such as are set up under the different speeds of travel; but the practical or financial results that accrue from the adoption of such expensively constructed bearings has led to a disinclination on the part of those responsible to treat with favor the many models and devices that are offered for effecting these objects.

Safety devices in connection with lifts exist galore, and there need be no accident of any kind connected with a moving lift that would not have provided for it checks and safeguards such as would minimize inconvenience and absolutely prevent injury resulting from a failure of any main member of the apparatus; yet it is found that the difficulties connected with keeping many of the safeguards in working order imposes conditions upon the attendants and owners such as render their adoption practically impossible.

It may be taken for granted that most of the leading firms of engineers of to-day have had proposed and submitted to them from time to time suggestions and models for overcoming some of the difficulties that they have long been familiar with, but concerning which they have felt that the cost of introducing such improvements would be greater than the advantages that would accrue and that such improvements could only be introduced by the imposition of other conditions and risks that would undoubtedly militate towards their being satisfactorily employed. That which engineers seek is not the hypothetical suggestion that may be termed a discovery, but rather the worked-out or embodied idea such as will bring it under the category or description of invention.—*Practical Engineer.*

Big Copper Cable Order.

The Mexican Light & Power Company, Limited, of Montreal, Canada, recently placed in this country an order for copper cable for transmission, which is probably the largest single order for transmission cable ever placed. The order calls for 1,500 miles of cable, weighing approximately 4,200,000 pounds. The cable is to be used on the Nicaxia-Mexico power transmission line, now under construction, and it will be supported on steel towers in spans of 500 feet. The length of the spans, together with the necessity of reducing the dip as much as possible and the high wind pressure, to be withstood, made the matter of cables one of considerable importance.

Turbine Vessel for Lake Ontario.

Shipping circles are watching with the keenest interest the voyage of the Turbinia, the vessel built for service on Lake Ontario between Toronto and Hamilton, now crossing the Atlantic, for upon the success of this vessel depends the future of the turbine for general purposes. Experts say the turbine for fast short-distance passenger traffic is a distinct success, but it has yet to be proved that turbine machinery is suitable for the propulsion of cargo vessels where speed is not the great requisite. The Turbinia, which has the distinction of being the first turbine equipped merchant vessel to cross the Atlantic, is fitted with Parson patent turbine engines, and three propellers, two forward and one reverse.

N. E. L. A. International Congress Papers.

Three papers will be presented at the International Electrical Congress at St. Louis on behalf of the National Electric Light Association as follows:

"American Practice in High-Tension Line Construction and Operation," by Dr. F. A. C. Perrine, Pittsfield, Mass.

"American Meter Practice," by G. Ross Green, Philadelphia, Pa.

"The Protection and Control of Large High-Tension Distribution Systems," by George N. Eastman, Chicago.

Panama Canal Electric Plants.

The electric light and tramway plants and the telephone system in the Panama Canal zone have been bought by a syndicate in which American capital is interested.

The "Four-Track News" for June.

The June number of the "Four-Track News" is full of matter interesting, not only to travelers but to the general reader. Its table of contents is unusually long and its contributors include a number of well known writers. The pleasures of summer are dealt with under various titles and include tales of the Adirondacks, of the Great Lakes, of the West, of the mountains and of the seashore. There is also much which will entertain the foreign traveler and the general reader will find entertainment in other articles not pertaining exclusively to travel. There are the usual interesting departments, poems, bits of humor, etc., and the illustrations are exceptionally attractive.—*New York News Bureau.*

F. N. Manross of Forestville, Conn., states that in order to handle the increase in his business he has been obliged to double the capacity of his building and add to the number of employes. The goods manufactured are hair-springs for electrical instruments. Mr. Manross asserts that the trade in this line has been the largest in his experience of 25 years.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 31, 1904.

Electric Railways and Appliances.

761,208. Railway-Signal. John P. Coleman, Edgewood, Pa., assignor to the Union Switch & Signal Company, Swissvale, Pa. Filed Sept. 4, 1903.

761,308. Trolley-Wheel Guard. Curtis W. Leslie, Pittsburg, Pa.; Theresa A. Leslie, administratrix of said Curtis W. Leslie deceased, assignor of one-third to William A. Maline and George J. Carew, composing the firm of Maline & Carew, Youngstown, O. Filed Nov. 5, 1903.

761,417. Safety-Apparatus for Use on Railway-Cars. Sidney H. Short, London, Eng., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 11, 1902.

761,421. Car-Fender. Leo M. Snyder, Dubois, Pa. Filed April 1, 1904.

761,432. Collector for Third-Rail Systems. Aldred K. Warren, New York City. Filed Feb. 25, 1903.

761,526. Insulated Rail-Joint. James C. Mock, Detroit, Mich. Filed Oct. 26, 1903.

761,549. Electric-Railway Crossing. Abraham A. Shobe and William Embley, Jerseyville, Ill. Filed Sept. 26, 1903.

761,553. Third-Rail Support. Louis Steinberger, New York City. Filed Dec. 7, 1903.

761,557 Car-Fender. Onesime Thibault, Fall River, Mass. Filed Jan. 13, 1904.

761,564-566-567. Trolley. John H. Walker, Lexington, Ky. Filed April 29, July 29 and Dec. 24, 1903.

761,565. Trolley Mechanism. John H. Walker, Lexington, Ky. Filed July 29, 1903.

761,574. Trolley-Protector. John H. Best, Jr., Sandusky, O. Filed Jan. 8, 1904.

761,611. Trolley-Pole. Charles F. Ritchtel, Bridgeport, Conn., assignor to the International Perfect Electrical Supply Company. Filed Sept. 17, 1903.

761,612. Car-Fender. Robert G. J. Sandifer, Hannibal, Mo., assignor of one-half to Isaac H. Christopher, same place. Filed Feb. 25, 1904.

Electric Lights and Appliances.

761,066. Light-Accumulator for Continuous and Alternating Electric Currents. August Engelsmann, Stuttgart, Germany. Filed Aug. 1, 1902.

761,133. Electric Switch. Henry P. Ball, New York City, assignor to the General Incandescent Arc Light Company of New York. Filed Sept. 30, 1902.

761,134. Automatic Short-Circuit Alarm for Electrical Gas-Lighting or Other Systems. Ferdinand M. Barrell, Brooklyn, N. Y. Filed June 15, 1903.

761,182. Electric-Arc Lamp. Joseph A. Rignon, Berlin, Germany. Filed Aug. 21, 1902.

761,379-380. Electric-Arc Lamp and Electric-Arc Lighting. John A. Heany, York, Pa., assignor to the Ter-Heany Developing Company, Charleston, W. Va. Original application filed Dec. 4, 1903. Divided and last application filed Feb. 4, 1904.

761,563. Switch for Electric Lamps. Charles Wagner, New York City, assignor to E. F. Caldwell & Co., same place. Filed Aug. 22, 1903.

Electrical Machinery and Apparatus.

761,117. Electrical Regulating Mechanism. Allyn B. Walton, Lorain, O., assignor to the National Vapor Stove & Manufacturing Company, same place. Filed June 25, 1902.

761,280. Potential-Indicator for High-Voltage Circuits. Jonathan E. Woodbridge, Albany, N. Y., assignor to the General Electric Company. Filed Oct. 30, 1902.

761,326. Machine for Molding Insulators. William H. Schorling, Brooklyn, N. Y., assignor to Henry M. Brookfield, New York City. Filed Jan. 21, 1904.

761,360. Electropneumatic Brake. John W. Cloud, London, Eng., assignor to the Westinghouse Air Brake Company, Pittsburg, Pa. Filed Sept. 30, 1901.

761,454. Manual and Automatic Circuit-Controller. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, same place. Filed Jan. 20, 1904.

761,466. Electric Cut-Out. Philip H. Fielding, New York City. Filed Oct. 10, 1903.

761,490. Safety Device for Electric Interlocking or Block-Signaling Apparatus. Frederick T. Hollins, Leytonstone, Eng. Filed Feb. 18, 1901.

761,634. Machine for Polishing Insulated Wire. Oliver T. Hungerford and Charles F. Kilgore, Belleville, N. J., assignors to the Hungerford Electric & Manufacturing Company, same place. Filed Sept. 29, 1903.

Telephones and Telephone Apparatus.

761,150. Telephone Attachment. George A. Cowgill Euphemia, O. Filed July 16, 1903.

761,616. Selective Party-Line Telephone System. Albert J. Springborn, Cleveland, O. Original application filed April 3, 1903. Divided and this application filed June 27, 1903.

Miscellaneous.

761,090. High-Tension Electric Condenser. Ignacy Moscicki, Fribourg, Switzerland. Filed Feb. 17, 1904.

761,102. Insulator. Leonard M. Randolph, Newark, N. J. Filed March 12, 1903.

761,111. Production of Tubes from Refractory Material. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed Aug. 28, 1902.

761,179. Electrical Device for Operating the Keys of Typewriters, etc. Jacob Pilsatneeks, Riga, Russia. Filed June 17, 1903.

761,198. Heat-Actuated Alarm System. Charles E. Buell, Camden, N. J. Filed May 28, 1903.

761,199. Apparatus for Producing an Alternating Magnetic Field for Therapeutic Purposes. Ernst Buhtz, Berlin, Germany, assignor of two-thirds to Rudolph Luthi and Andreas Guritt, same place. Filed Jan 30, 1904.

761,204-205. Method of Making Electrical Heating Apparatus and Electrical Heating Apparatus. Charles E. Carpenter, New York City, assignor to the Cutler Hammer Manufacturing Company. Filed Nov. 20, 1902, and Jan. 27, 1904.

761,250. Electric Heater. Edwin F. Porter, Boston, Mass., assignor by mesne assignments, to Benjamin F. Peach, Lynn, Mass. Filed Oct. 17, 1898.

761,256. Wireless Telegraphy. Charles K. Salisbury, Lincoln Township Blackhawk County, Ia. Filed Oct. 30, 1902.

761,267. Magneto. Walter F. Taylor, Brookline, Mass., assignor to the Holtzer-Cabot Electric Company. Filed Feb. 19, 1904.

761,294. Post for Supporting Telegraph-Wires, etc. Leon Griveaud, Paris, France. Filed July 28, 1902.

761,345. Storage Battery. Theodore A. Willard, Cleveland, O., assignor to the Willard Storage Battery Company, same place. Filed Sept. 11, 1903.

761,450. System of Telegraphy. John L. Creveling, New York City. Filed April 11, 1903.

761,459. System for Operation of Magnetic Clutches. Arthur C. Eastwood, Cleveland, O. Filed Jan. 14, 1904.

761,465. Electrical Appliance. Philip H. Fielding, New York City. Filed Aug. 26, 1903.

761,572. Electric Fire and Burglar Alarm. William C. Barger, Mammoth, W. Va. Filed March 31, 1904.

Reissue.

12,223. Alternating-Current Transformation. Maurice Hutin and Maurice Leblanc, Paris, France, assignors, by mesne assignments, to George Westinghouse, Pittsburg, Pa. Filed April 20, 1904. Original No. 754,371, dated March 8, 1904.

THE TELEPHONE WORLD.

Telephone Company Gets Right of Way in Cincinnati, O.

The Probate Court lately decided that the Queen City Telephone Company was entitled to the use of the streets of Cincinnati for its wires and prescribes the manner in which the franchise should be exercised. This action, if sustained by the higher courts, breaks the monopoly hitherto held by the Bell Telephone Company in Cincinnati. Notice was given of appeal.

Reduction in Rates.

The New York & New Jersey Telephone Company reduces rates to regular subscribers in Brooklyn, Queens and Richmond, five cents on messages to points in Greater New York, where the rate is 15 cents or more.

The Utah Independent Telephone Company expects to have its system in full operation by the 1st of July. It will start the service in Salt Lake City about June 15, when an opening reception to the public will be given in its handsome new building, but it is not expected that everything will be in good working order until two weeks later. The opening of the new system has been delayed considerably by the bad weather of the late spring having come at a time which held up completely for several weeks the work of putting in the Ogden plant.

The Inter-Ocean Telephone Company has been granted the privilege of entering the village of Geneseo, N. Y., with its telephone lines and soon will establish a day and night office. It has a trunk line which runs from Canandaigua to Dansville and passes through the town of Geneseo about four miles east of the village. A stub from these lines will be run to Geneseo.

The Acme Telephone Company of Phillipsburg, O., has increased its capital stock from $8,000 to $15,000. Officers have been elected as follows: N. W. Rinehart, president and manager; S. A. Mosby, vice-president; E. Shellabarger, treasurer; A. M. Myers, secretary. The officers and E. E. Brumbaugh constitute the board of directors. A dividend of 15 per cent. was declared.

The Atlantic Coast Telephone Company opened its long distance telephone service a short time ago. The line crossing New Jersey connects with the Eastern telephone system in Camden, giving communication with practically the whole of that State, and with the Keystone Company in Philadelphia, thus connecting Atlantic City with Baltimore, Harrisburg and a host of other more distant points.

A new telephone line has been installed in Washington, from Prescott down the Touchet to Riverside and Walla Walla, connecting with most of the ranches by the way. The line was built and is owned by the farmers living adjacent to the territory through which it runs.

The Bureau County Mutual Telephone Company of Manilus, Ill., has increased its capital stock from $2,500 to $20,000.

The Delmarvia Telephone Company has established connections between the system in Wilmington, Del., and Atlantic City, N. J.

Increase of Telephone Systems Throughout the Country.

A preliminary report on the telephone systems of the country was issued last month by the Census Bureau, showing that there are 9,136 systems and lines in the United States, 4,900,450 miles of single wire and 2,315,297 telephones. In addition there are several systems in Hawaii and one in Alaska, using 2,493 telephones, with 4,732 miles of single wire.

The number of officials and clerks employed is 14,124, and their salaries are $9,885,886. The wage earners employed number 64,628, and their wages amount to $26,369,735. The total revenue for the year ending December 31, 1902, was $86,825,536, and the total expenses $61,152,823; dividends, $14,982,719; interest on bonds, $3,511,948, and net surplus, $7,178,046.

Chicago Telephone Dividend.

The directors of the Chicago Telephone Company will meet to-day (Wednesday) to act on dividends. The usual quarterly rate is expected. An official of the company, when asked about the report that another increase in the capital stock was contemplated, said: "It has been customary to put out new stock as the business demands it, but there have been no recent developments along these lines. I cannot say what will be done at the meeting."

The Weare Telephone Company of North Weare, N. H., has been organized and a corporate charter is to be applied for at once. A sufficient number of subscribers has already been obtained to assure the success of the enterprise and quite favorable terms have been made with the New England Company. The directors are Frank Simons, William S. B. Herbert, Seth Straw, Loran Clement and Dudley H. Farr.

The officials of the Pittsburg & Allegheny Telephone Company will install an automatic exchange in Wilkinsburg, Pa., in a short time. The plan has been considered for some time, and the Wilkinsburg exchange has been the place selected for the practical tests of the system.

The Farmers' Co-operative Telephone Company is authorized to build and maintain a rural telephone line at Traverse, Minn. Its capital stock is placed at $12,000, and J. H. Hunter, C. L. Nelson, F. E. Briggs and a large number of others are the incorporators.

The Cumberland Telephone & Telegraph Company has a force of men in Milton, Ky., building an exchange, which when completed will have about 100 subscribers.

The Franklin Telephone & Telegraph Company will make application for a charter to operate an Independent line through upper Bucks County, Pa.

The Carroll County Independent Telephone Company of Savannah, Ill., has increased its capital stock from $75,000 to $150,000.

The Forest City Telephone Company, of Forest City, Ill., has increased the number of directors from three to five.

The Laingsburg Telephone Company has opened a patrol station at Park Lake, Mich.

Remarkable Growth of Burlington and Augusta Company of Iowa.

The Burlington and Augusta Telephone Company, which was originally organized to build a single line from Burlington to Augusta, has developed into so large an enterprise that there is thought of reincorporating with enlarged capital. The present capitalization is $5,000. The extensions made and others contemplated will justify, it is believed, a capitalization of $20,000. The company now has 13 lines leading into Burlington and connected with the Mississippi Valley (Hubinger) Telephone Company's exchange.

The company has 148 instruments in use at an annual rental of $14 a year. The patrons are principally farmers, who find the telephone not only a great convenience, but practically a business necessity. The system is very popular and there is a lively demand, and hence the necessity for increased capital.

The officers are E. W. Ramkey, president and manager; Henry Magel, vice-president and assistant manager; N. C Hansen, secretary and treasurer.

Rochester, N. Y., Company May Enlarge Plant.

Record of a real estate transfer from A. M. Dumond and others to the Rochester Telephone Company was recently filed in the County Clerk's office George R. Fuller, secretary and treasurer of the telephone company, said in regard to the purchase:

"We bought the property in Stone street which adjoins our main building. This land has a frontage of 68 feet on Stone street and extends back to Minerva place. We purchased the property to provide for the extension of our plant should such a move be necessary. We have made no plans for extension at present and may not have in the near future, but we want to be prepared."

A telephone which is intended for use exclusively in situations where cross connections may occur between the telephone conductors and high-tension circuits has been invented by Messrs. Siemens & Halske. The feature of the instrument is that there are no metal parts outside the case which can be touched. Instead, everything is made from either hard or soft rubber, and all the metallic parts of the instrument are contained in a walnut case. The instrument is also provided with high-tension fuses, suitable for 3,000, 5,000 or 10,000 volts, depending on the voltage used in the station or district in question.

The Elkton, S. D., Telephone Company is extending its line southwest of that town.

Telephone Incorporations.

The Flora & Bringhurst Co-operative Telephone Company, Flora, Ind. Capital stock, $12,000. Incorporators: Harvey Thomas, William F. Wagoner and Spurgeon Tidrick.

The Hector, Logan & Burdett Telephone Company, Burdett, N. Y. Capital stock, $5,000. Directors: C. D. Smead, H. F. Logan, W. B. Hueston and J. D. Mallory, of Hector.

The Northern Tioga Telephone Company, Newark Valley, N. Y. Capital stock, $10,000. Incorporators: G. E. Purple, F. W. Witter and Dr. H. L. Knapp, all of Newark Valley.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Arlington, S. D.—A new flour mill is to be erected here by capitalists who will likely make an arrangement whereby they will furnish this place with electric lights.

Batesburg, S. C.—At the recent special election it was favorably voted to issue $20,000 bonds for the erection of an electric light and waterworks plant.

Bedford, O.—The Bedford Electric Light & Power Company has been incorporated with a capital of $50,000 by E. E. Naudeville, Edward Roberts, G. E. Smith and others.

Bridgeport, Conn.—The Union Metallic Cartridge Company of this city is preparing for the erection of a large plant for the purpose of generating electricity for light and power of its own.

Cambridge, Neb.—The Cambridge electric light plant, which has been operated here under the sole management of P. B. Cole, has been organized into a corporation under the name of the Cambridge Electric Light Company, with an authorized capital of $10,000.

Cincinnati, O.—At a recent meeting of the city council several resolutions were passed ordering additional arc lights placed at various street corners.

Covington, Ky.—The right of this city to set up an electric plant to furnish light and power here was recently established by the United States Supreme Court.

Edmeston, N. Y.—The Edmeston Light, Heat & Power Company has been incorporated to manufacture electricity. Its capital stock is $6,000, and the incorporators are Charles T. Coats, H. Underwood and others.

Mt. Pleasant, Pa.—An intended corporation to be called the Hartigan Electric Light, Heat & Power Company, whose object is the manufacture and supply of light, heat and power by means of electricity, to the public in this borough, will apply for a charter June 21.

Muncie, Ind.—The Muncie Electric Light Company has been granted a new franchise.

Newberry, S. C.—In reference to improving the present system of lights, which is entirely inadequate for the city's needs, it is estimated that an up-to-date plant can be installed at a cost not exceeding $5,000. The matter is now in the hands of the city council as to whether or not the city can go further into debt just at this time.

Newton Falls, O.—The council has decided that the village should be lighted by electricity.

Oxford, Miss.—The proposition to issue bonds for the building of an addition to the public school building, and also to make the necessary improvements to the electric light plant, was lately voted in favor.

Pentwater, Mich.—This town is to have an electric light plant.

Quincy, Ill.—The Quincy Gas & Electric Company has perfected plans which will require an expenditure of $50,000 for improvements during the coming summer.

Ridgefarm, Ill.—An electric light plant is to be erected here to replace the one destroyed by a recent fire. Henderson & Linn will erect the new plant.

San Jose, Ill.—This town needs an electric light plant.

Sherman, Tex.—J. F. Strickland, the prime mover in the electric light companies of Waxahachie, Hillsboro and Cleburne, has been here relative to installing an electric light plant. P. B. Stichter, of Cleburne, is also interested.

South Stillwater, Minn.—The village council has decided to install a new electric lighting plant.

Walla Walla, Wash.—The Oregon & Washington Light & Power Company will erect a large new light plant here.

Waterloo, Ind.—The town board is considering the electric light question.

West Point, Ia.—An electric light plant may be installed here.

Winnipeg, Man.—The city electrician has recommended that many additional lights be placed at various street corners.

STREET RAILWAYS.

Almont, Mich.—Surveyors under the supervision of Engineer Q. A. Thomas are laying out the electric line from Romeo to this place. Great enthusiasm is manifested along the route.

Baltimore, Md.—The Maryland Electric Railways Company is once more seeking the right to operate a street railway line in this city. An ordinance granting the company authority to lay tracks on streets in every section of the city has been introduced in the second branch of the city council and referred to the committee on city passenger railways. The passage of the ordinance will mean the expenditure of $6,000,000 or $8,000,000 here for construction, street paving and other work.

Detroit Mich.—It is stated that a new electric line is now planned from this city to Adrian. Belleville men are pushing the scheme and George W. Moore is their attorney.

Le Roy, N. Y.—John T. Mooney, general superintendent, and the chief engineer of the Buffalo & Depew Railway Company, have sent favorable reports to the higher officials of the company in Philadelphia in regard to the proposed line between here and Perry.

Marinette, Wis.—A project to build an interurban line from here to Green Bay is now under way, and Henry Higgins, formerly president of the Marinette Street Railway Company, is said to be backing it. This will connect this city with the Green Bay interurban, which will soon be connected with the interurban at Kaukauna, giving a direct electrical line from here to Fond du Lac and ultimately to Milwaukee.

Mt. Sterling, Ky.—The Mt. Sterling Short Line Railway Company of this city has recently been incorporated. The road is to be 9 miles long and will be built at once, connecting with the Lexington & Eastern at Indian Fields. It is believed the road will be the means of building an electric line to Lexington, and possibly from this city to Sharpsburg.

New York City.—Directors of the Interborough Rapid Transit Company met last week at August Belmont's office and decided on the form of electric equipment to be used on the New York and Putnam road, control of which has been purchased from the New York Central. It was decided to use a covered third rail between 155th street and Yonkers, because much of that route is on the surface. It is estimated that the cost of converting the Yonkers branch into an electric road will be less than $25,000 a mile. All that is needed is a third rail and wiring.

Newport, R. I.—The mechanical department of the New York, New Haven & Hartford Railroad has completed plans for the installation of an electric line between this city and Fall River to replace the steam road.

Portland, Ind.—The Portland, Montpelier, Warren & Huntington Railway Company, with a capital stock of $15,000, was incorporated recently. The company proposes to operate an electric railway running between and within this city, Montpelier, Warren and Huntington. The incorporators are James West, Loi Huffman, D. A. Williamson, Thomas H. Bradstreet, D. A. Bryson, W. E. Sinclair and Scott Mills. The principal place of business will be at Montpelier.

Richmond, Va.—The officers of the Citizens' Rapid Transit Company have announced that contracts have been let for the proposed electric line across the city and work is to be started. The road will cover a part of the city not now served by electric lines and follows a route inaccessible before the recent improvements in electric power.

Rockaway Beach, N. Y.—Work has been started on a new power house to be erected by the Long Island Railroad Company on the "Y" Hammel's station. This is the beginning of the company's plans for electrifying the entire route between Long Island City and Brooklyn and the Rockaway branch. Another sub-station is to be built at Woodhaven Junction. The entire Long Island system west of Jamaica on the Atlantic Avenue and Rockaway division will be operated by electricity next year.

Roslyn, N. Y.—Representatives of the Central Long Island Electric Light & Railroad Company are busily engaged in getting consents of property owners along the line of the proposed route of the company between Huntington and this place. A number of persons have signed consents, as it is represented that Messrs. Ladew and Rogers, prominent capitalists, are at the head of the company.

Sandusky, O.—J. C. Parker is the promoter of the Sandusky, Clyde, Tiffin & Southern Electric Railway.

St. Louis, Mo.—W. T. Davis will be superintendent of construction of the interurban electric line between Alton and this city,

Wabash, Ind.—The Wabash Exchange is arranging for the building of a trolley line north of this city.

Warren, O.—A franchise is to be granted to the Warren, Cortland & Jefferson Traction Company for the construction of an electric road here.

POWER PLANTS.

Boise, Ida.—The plant of the Highland Power Company on the Boise River, 20 miles above this city, was lately swept away. The loss is about $150,000.

Knoxville, Tenn.—Several capitalists are trying to form a company relative to developing power for lighting purposes. United States Marshal R. W. Austin is said to be interested.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, $12\frac{5}{8}$@$12\frac{3}{4}$c.; Lake $12\frac{3}{4}$@13c.; casting, $12\frac{3}{8}$@$12\frac{1}{2}$c.

The Twin City Rapid Transit Company has declared a regular quarterly dividend of $1\frac{3}{4}$ per cent. on the preferred stock.

Chicago Union Traction receivers, under advice of their attorneys, have decided to appeal the Miller case direct to the United States Supreme Court.

The Galesburg Railway & Light Company, with its principal office in Portland, Me., has been incorporated with a capital of $1,500,000.

Directors of the Chicago City Railway Company have declared a dividend of $2\frac{1}{4}$ per cent., payable June 30, to stockholders of record June 13.

All the new stock of the Cambridge (Mass.) Electric Light Company and also all the stock of the Cambridge Electric Securities Company has been subscribed.

The directors of the Boston Suburban Electric Company have declared a dividend of 50 cents a share on the preferred stock, payable July 15, to stock of record June 10.

A stockholders' special meeting of the South Side Elevated Company, of Chicago, has been called for August 9 to authorize an issue of $8,000,000 $4\frac{1}{2}$ per cent. bonds.

The Interborough Rapid Transit Company of New York has declared a quarterly dividend of $1\frac{1}{2}$ per cent. under the Manhattan Railway lease, payable July 1. Books close June 10 and reopen June 22.

Stockholders of the Philadelphia Electric Company are said to have made an unexpected prompt response to the assessment called on the stock. Many stockholders have paid the entire $2.50 called for June 1 and December 1.

The Public Service Corporation of New Jersey has installed 60 new open cars on its lines between Jersey City and Trenton. They will be used principally for the through service inaugurated between Camdem and Jersey City.

It has been estimated that Philadelphia Rapid Transit gross earnings for the fiscal year ending with this month will approach $15,800,000, or an increase over the 1903 fiscal year of between $500,000 and $600,000.

The Cataract Electrical Supply Company of Buffalo, N. Y., has been incorporated with $100,000 capital. The directors are Nelson S. Hallett, Francis T. McDonald, Eldwin B. Collinster, Arthur R. Jenkins and Harry B. Lamson.

Referring to the circular letter of the General Electric Company, dated May 20, to stockholders, the New York Stock Exchange committee on securities rules—"that all transactions in the capital stock of said company on Wednesday, June 15, 1904, except for cash, shall be 'ex-rights,'"

Stockholders of the New England Telephone & Telegraph Company of June 18 will be entitled to subscribe at par for 30,881 shares of new stock on the basis of one share of new stock for every seven shares held. The right to subscribe will expire at the close of business Saturday, July 16.

Bondholders of the Philadelphia & Lehigh Valley Traction Company have adopted a reorganization plan by which the entire system will be made compact with a new first mortgage for $4,600,000—$1,830,000 of the bonds to represent cash for the company's use in building a new power house, light plant and machine shop, paying preferred claims and receiver's certificates and redeeming securities pledged as collateral.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price June 6.
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	144
Metropolitan Street Railway	$109\frac{5}{8}$
Metropolitan Securities	$77\frac{3}{8}$
Ninth Avenue	200
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	$46\frac{7}{8}$
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	20
United Company of New Jersey	266
Philadelphia.	
Consolidated Traction of New Jersey	$65\frac{1}{4}$
Philadelphia Traction	$95\frac{3}{4}$
Union Traction, $17.50 paid	$49\frac{3}{4}$
Boston.	
Boston Elevated, full paid	141
West End Street, com	90
do. do. do. pref	111
Chicago.	
City Railway	158
North Chicago	71
Union Traction, com	$5\frac{1}{2}$
do. do. pref	29
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	27
do. do. pref	60
Electric Lead Reduction	$\frac{5}{8}$
Electric Vehicle, com	$6\frac{1}{4}$
do. do. pref	$9\frac{1}{2}$
Westinghouse, com	157
do. pref	235
General Electric	156
Boston.	
Edison Electric Illuminating	$234\frac{1}{4}$
General Electric	155
Massachusetts Electric Companies, com	$17\frac{3}{4}$
do. do. do. pref	70
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	145
National Carbon, com	28
do. do. pref	102
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	$57\frac{1}{2}$
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	$125\frac{1}{4}$
Western Telephone Company	$8\frac{3}{8}$
New England Telephone Company	119
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	$1\frac{1}{2}$
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	86
Miscellaneous.	
Chicago Telephone Company	116
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

A Craze for Municipal Ownership.

The "Windy City" would seem a very appropriate name for Chicago just at present. A short time ago its enthusiastic citizens voted on a proposition to own all the street railways—without any funds being appropriated or in view for the purpose—and now the city wants to own and operate the gas and electric light plants. Decidedly Chicago has a bad attack of municipal ownership.

The City Council passed an order on June 6 directing the Committee on State Legislation to prepare a bill providing for municipal ownership of these public utilities. The bill will authorize the city to issue certificates against the properties for the purchase or construction of gas or electric lighting plants.

In a communication accompanying the order Mayor Harrison said that the Corporation Counsel in a recent opinion held that the city had the inherent right to sell gas and electric power to its citizens, but that the unfortunate condition of the municipal finances would not allow the appropriation of a sufficient amount to develop the systems.

On the subject of municipal ownership Chicago would seem to be very much in the position of a man who has ordered and eaten a good dinner and finds that he has no money wherewith to pay for it. The people have signified by ballot that they desire the city to obtain the street railways and run them as municipal enterprises, and yet the Illinois Legislature will have to be appealed to before any money can be obtained for that purpose or for the purpose of operating gas and electric light plants.

If municipal ownership ever becomes a fact instead of a theory in Chicago the property holders will wonder why the tax rate has jumped so suddenly. And as is generally the way probably more than three-quarters of those who voted for and advocate municipal ownership do not own a handful of dirt in the way of land and consequently pay no tax unless a dog or poll tax.

* * *

An Object. Lesson.

One of the reasons why the overhead wires and cables in the Borough of Brooklyn should be placed underground, as advocated by us a short time ago in these columns, was made apparent last week. A heavy thunder-storm happened to pass over Greater New York during the night and as a result a large number of cables in Brooklyn were damaged by lightning. When an attempt was made to turn on the electric power in the early morning, for operating surface and elevated railroad cars, a number of fires started. Referring to the subject the vice-president and general manager of the Brooklyn Rapid Transit Company, Mr. John F. Calderwood, is reported as saying:

"We had trouble all night with our wires on account of the lightning. The wires were struck a number of times, and the insulations were injured at these points. When the full current was turned on, at 6 o'clock in the morning, fire broke out in the weakened places. The trouble was caused solely by lightning."

The trouble undoubtedly was caused by lightning, but was directly due to the fact that the wires and cables are above ground. Numerous short circuits occurred during the so-called rush hours, cars were stalled and some half million residents of Brooklyn were seriously inconvenienced. The wonder is that people continue to reside in the borough across the East River and patiently put up with transportation inconveniences.

The same storm that passed over Brook-

lyn crossed Manhattan and yet in the latter borough not a car was stalled through damaged cables. And naturally not, as all conductors are where they belong—underground.

As we have stated before it would be too much to ask the Brooklyn Rapid Transit Company to place all its wires underground at once, and yet were the proper authorities to insist on a move being made toward taking down poles it would be appreciated by all except a few stockholders.

* * *

An Electric Laboratory Furnace. An electric furnace for laboratory work has recently been invented by Prof. Harmon V. Morse of Johns Hopkins University. This furnace is radically different from any heretofore brought out and is said to meet every requirement for laboratory work in chemistry.

In order that satisfactory results may be obtained in the many forms of heating necessary in laboratory practice four conditions must be satisfied: First, the heat must be developed economically; second, it must be possible to obtain definite temperatures; third, it must be possible to maintain constant temperatures for long periods; fourth, products of combustion must not be allowed to come in contact with the substances heated.

Chemists have long seen that the solution of this problem was to be looked for in the application of the electric current, which yields no products of combustion and which can be developed at a constant and regular rate.

Prof. Morse's electric heater consists of an ordinary copper oven incased in a box doubly lined with asbestos, with air space between, the whole covered with aluminum paint, which is not affected by high temperatures, is a very poor heat radiator and preserves the asbestos from shredding. This arrangement practically prevents any loss of reat by radiation.

The source of heat is in the stove, which is placed within the copper oven. The construction of this stove is the ingenious part of the apparatus and requires the highest type of experimental skill. It is constructed of a number of parallel slabs of soapstone coated with graphite, the soapstone being unaffected by the heat. The graphite must be evenly distributed over the slabs of soapstone, in order that the heat may be developed uniformly over the surface. The oven itself is not so difficult of construction, but the making of the heating apparatus within, through which the electric current has passed, has formed the great stumbling block in the way of former investigators. The use of soapstone in constructing the heater is the result of the remarkable inventive genius for which Prof. Morse is well known.

The furnace has been found to work admirably and can be operated, so it is claimed, at a cost of one cent a day.

A constant temperature of 150 degrees can be obtained for eight hours at a stretch at a cost of three-fourths of a cent. It is most probable that Prof. Morse's furnace will entirely displace the old gas furnaces now in general use, and it is certain that it will add much to the exactness with which chemical processes may be carried out.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

We are informed that the acceptances of membership in the International Electrical Congress, to be held September 12-17 in St. Louis, number 1,702, and that over 160 specially invited papers are promised. Over 1,000 certificates of membership have been issued to those who have become members by sending in their subscription.

Mr. Anson W. Burchard has been appointed assistant to President Coffin, a recently created office of the General Electric Company.

M. Malcotti, an Italian engineer resident of Brussels, has invented an instrument which he calls a telecriptograph, and which will reproduce in print all conversations held over the telephone. He has already secured patents in several European countries and in the United States.

Dr. Charles Baskerville, of the University of North Carolina, and discoverer of the two elements of thorium, is coming to this city as head of the department of chemistry of the College of the City of New York.

Alexander Graham Bell is quoted as follows in an interview in the Boston *Globe*: "When I began my experiments upon the telephone I had no scientific knowledge of electricity. I knew practically nothing about it, and had it been otherwise I could never have made the discoveries which culminated in my success. I don't believe any electrician could have invented the telephone."

An article on obtaining electric energy direct from coal appears in the "*Revue Pratique de l'Electricite*. The basis of the experiments was provided by the discovery made by Oswald, who filled two glasses joined by a tube with a solution of sulphate of potassium. In one of these glasses is inserted a platinum plate, in the other a zinc plate, and these being connected by a galvanometer, polarization takes place. By adding sulphuric acid to the glass containing the zinc, practically no effect follows; but by pouring it into the glass with the platinum plate a powerful current results. In a similar way Dr. Borchers used generator gas instead of coal, and chlorite of zinc for the electrolyte. The results were the same.

It is said that the demand for electricians in the Artillery Corps of the United States Army is far in excess of the supply. The positions that are open require a certain amount of technical knowledge which seems to be the drawback. The salary of $75 a month is the highest pay of any of the enlisted force, yet, notwithstanding this inducement, it appears that the restrictions in military life are too great to attract capable men. The department has existed for over a year, and so far only six applicants have been appointed who in all respects were qualified. Six others are being trained in the practical discharge of duties of the position at Fort Totten, N. Y., but there still remains 13 appointments for master electricians.

A dispatch from St. Petersburg states that Colonel Perky, in a communication to the Electric Technical Society on the discovery of a means of utilizing wireless telegraphy to explode submarine mines, says an apparatus invented by him can change the position of mines already submerged, makes mines attached to the bottom rise to the surface and explode and render fixed mines not connected to a port by wires harmless to specified vessels and dangerous to hostile ones. Colonel Perky refuses to reveal the details of his invention, which is causing a great sensation in naval circles.

Rear Admiral Rogers, commanding the Navy Yard in Brooklyn, last week received the first wireless telegraphic message sent to the yard. The board having in charge the tests of the various wireless systems is in session daily at the Navy Yard, and this week the Topeka, which has been fitted up with a wireless system, will go out to sea and attempt to communicate with the station at Navesink and also with the Navy Yard.

A short time ago Prof. C. P. Steinmetz lectured on the subject of lightning before a large gathering at Union College in Schenectady. He demonstrated how

modern investigations into the real character of lighting have revealed facts not previously accredited to it, and showed how much farther modern researches within the last generation have advanced the study of this part of electricity. Among other things Prof. Steinmetz said: "The exact amount of time occupied by a lightning flash is a matter of considerable interest not only because of the difficulty in ascertaining the amount of time so consumed, but also because of the calculations as to other details of its nature which depend for their verification on the finding out of this time. It has been estimated that one ten-thousandth of a second is about the amount of time and has been generally so accepted. Nevertheless this cannot be proven and all deductions from this hypothesis are naturally only hypotheses.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

Introduction.

Wiring is now one of the most important departments of electrical engineering. In the last 15 years it has developed from a comparatively haphazard attempt to conduct current to the various lamps in a building into a systematized code of principles and practices based upon the rulings of the Board of Fire Underwriters, in conjunction with the recommendations of the most prominent society of electrical experts in the United States.

It has in fact assumed an importance in the building arts second to none. No large structure is erected at present without provision being made in the plans for electric wiring. In many cases it has entirely superseded gas and is the only means of lighting considered.

The development of the art of wiring has meant the development of industries dependent upon it for their existence. Immense amounts of capital are in use for the manufacture of insulated wire of many descriptions; for the manufacture of sockets, switches, cut-outs, lamps, lampcord, iron pipe conduit, and a host of smaller appliances essential to the installation of a wiring system. The experimental stage has been passed and electric wiring and electric lighting have entered into the administration of the affairs of our large cities as an economic measure required for public safety and convenience. So we enter, as it were, upon a new era in the application of electricity for electric light and power, and this has had enormous influence upon the development and progress of every large city and town.

Regarding the subject of wiring from such standpoints it is easy to understand the importance to be attached to those principles which lie at the very root of the subject. When it is remembered, that the greater part of the wiring is still to be done in thousands of homes and buildings of the future; that the universal application of electricity for electric lighting will become a fact as soon as the price of electricity is within the means of the humbler classes, and finally that its hygienic benefits are so pronounced both in summer and winter that it must in the course of time be regarded as an indispensable adjunct to home comfort; it will be seen that the art which will reach its greatest development and application in that direction for that purpose is electric wiring.

Statistics may be found in a variety of magazines showing the enormous growth of electric lighting in the United States, but one of the most unique records is that of the fan motor load which is experienced at certain hours of the day in large cities during the summer months.

Recently the New York Stock Exchange expended thousands of dollars in the construction of an equipment largely electrical for keeping the air of the exchange 10 degrees cooler than the air of the street during the heated period. Fans 12 feet in diameter are employed for this purpose attached to powerful motors. The air is filtered as it passes through into the exchange thus relieved of every particle of dust.

Purpose of Wiring.—It is not only the distribution of current which is kept in view by laying out a wiring system, but the proportioning of the sizes of wire employed so as to limit the loss of pressure from point to point as required. In the lighting of incandescent lamps it is necessary to supply a definite pressure to the terminals in order to produce the requisite light. The incandescent lamp is peculiarly sensitive to changes of pressure, losing a large percentage of its illuminating power with a slight drop in pressure and gaining rapidly in candle power as the pressure increases. The life of the lamp is seriously affected by more than the necessary pressure; it rapidly blackens and soon becomes valueless unless such irregularities are checked in the power supply.

Ohm's Law.—Few discoveries of modern times rank in importance with the discovery of Ohm's Law. A study of the principles of electric wiring cannot be carried on without the reader possessing a thoroughly intelligent conception of the meaning and application of this law.

The law in itself is exceedingly simple, and expresses the relationship between amperes, volts and ohms. In order to understand the law the first thing to be done is to gain a knowledge of what is meant by a volt, an ohm and an ampere. In order to do this satisfactorily, illustrations must be employed which though not presenting an ideal simile, yet will serve to convey the idea in view.

Volts.—When a current of electricity passes through a circuit it is set into motion by what is termed electromotive force. If it is impossible to imagine water or steam or any other fluid passing through a pipe without pressure, it is likewise impossible to imagine a current flowing through a circuit without electromotive force. In other words, the force which moves or tends to move electricity is electromotive force.

Electromotive force is measured in volts just as steam pressure comparatively is measured in pounds. The general expression, electromotive force and its measurement in volts, may be understood by reference to the general expression, pressure and its measure in pounds.

Amperes.—If a certain quantity of electricity can be delivered by a current in one second it is because the current has a certain strength. If the current is capable of delivering twice as much in one case as another in one second, it obviously possesses twice the strength. A unit quantity of electricity is called a coulomb. The question now is, what is a coulomb? It can be answered in a practical manner by stating that every particle of copper, silver, gold, nickel or any other metal in an electro-plating bath is carried over and deposited on the articles to be plated, thickly or thinly, according to the number of coulombs that have been employed. For instance, one coulomb per second will carry over one-twenty-ninth of an ounce of copper in an hour. Each coulomb always carries over a definite quantity. Each second the same amount is carried over, so that in the course of one hour (or 3,600 seconds) a weight of copper equal to one-twenty-ninth of an ounce has been deposited.

A current of electricity which will give one coulomb per second has a strength of one ampere. This means that a current of one ampere will plate over a weight of copper equal to one-twenty-ninth of an ounce per hour. If the current has a strength of two amperes it will plate twice as much per hour, and so on. A current of the strength of five amperes will give five coulombs per second, ten

amperes ten coulombs per second, etc., as indicated in the table:

Table showing relation between coulombs and amperes.

Strength of current. Amperes.	Coulombs per second.
1	1
2	2
3	3
4	4
5	5
10	10
50	50
100	100

Table showing relationship between coulombs, copper deposited and strength of current.

Amperes.	Coulombs.	Hours.	Pounds.	Ounces.	Grains.
1	36,000	10			180
5	180,000	"		2	26
10	360,000	"		4	52
20	720,000	"		8	104
30	1,080,000	"		12	156
40	1,440,000	"	1		208
50	1,800,000	"	1	4	260

It is of great importance to grasp the meaning of Ohm's Law, not only as an abstract relationship between current, electromotive force and resistance, but as a physical relationship, which may be proved by illustration in many ways. The following tables are illustrative of the application of Ohm's Law in three successive cases in which the current remains constant, the volts constant and the resistance constant. The influence of this condition is interesting in each table and shows that either amperes, volts or ohms can be calculated by knowing the other two, as follows:

Table I—Amperes = volts ÷ ohms.
Table II—Volts = amperes × ohms.
Table III—Ohms = volts ÷ amperes.

Table I.—C = E ÷ R.

Current remains constant.

Amperes.	Volts.	Ohms.
10	10	1
"	20	2
"	30	3
"	40	4
"	50	5

Table II.—E = C × R.

Volts remain constant.

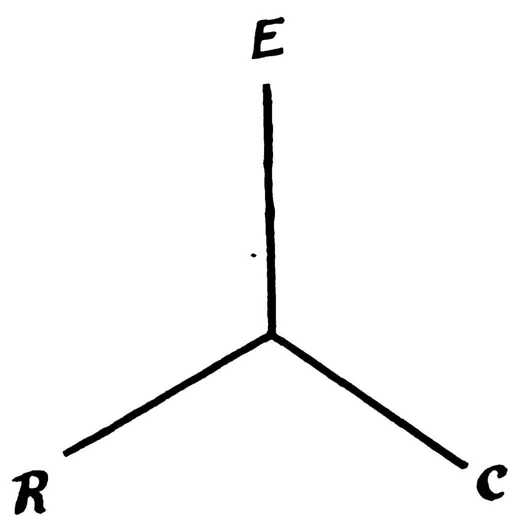
Amperes.	Volts.	Ohms.
10	100	10
20	"	5
30	"	3.333
40	"	2.5
50	"	2.0

Table III.—R = E ÷ C.

Ohms remain constant.

Amperes.	Volts.	Ohms.
10	100	10
20	200	"
30	300	"
40	400	"
50	500	

In the cases cited E is divided twice, once by R and once by C, and R and C are multiplied together. So it is easy to remember that the two factors multiplied together are the two which are respectfully divided into E to get either C or R. For instance E ÷ by either C or R = either R or C, and C × R = E, which might be represented by the following sketch:



The two lower ones multiplied give E, the upper one divided by either of the lower, gives the remaining character. It is very convenient to those unaccustomed to algebraic forms to carry an image in the mind as indicated above with the method of handling it.

Drop of Potential.—A fact with which every one should be familiar is that it is impossible to transmit power from place to place without a loss. If steam is sent through a pipe to run an engine, the longer the pipe the greater the loss of power before the steam is utilized. The smaller the diameter of a pipe the greater the waste of power in transmitting. The same principle applies to wire rope transmission, in which a very large percentage of power disappears between the points sending and receiving it, as in the case of cable car systems, passenger elevators, etc.

A wire conducting electric power is subject to the same law, which manifests itself in two ways; first, the pressure or voltage diminishes; secondly, the wire develops heat. The loss of pressure, which may be shown by the voltmeter, can be readily calculated by Ohm's Law:

Drop = amperes × ohms.

For instance, if the problem were given: what is the drop of potential in a line of 10 ohms resistance carrying a current of 10 amperes? the answer would be

Drop = 10 × 10 = 100 volts.

Rule.—To calculate the drop in a line multiply the amperes by the ohms.

Table showing drop in a line.

Size of wire No. 10 B & S	Amperes.	Ohms.	Drop in volts.
1,000 feet.	10	1	10
2,000 "	"	2	20
3,000 "	"	3	30
4,000 "	"	4	40
5,000 "	"	5	50

It is evident from an inspection of the table that the drop increases as the resistance or current increases. The loss of power in a line can be diminished by reducing the current in the line or reducing the resistance of the line.

Resistance of Wires.—The resistance of a wire depends upon the length of the wire, its diameter or cross section, and the metal of which it is composed. Resistance is a native property such as elasticity, ductility, malleability, and depends upon the quality or purity of the metal, or the mixture composing the alloy, as in the case of german silver wire.

If conductors had no resistance, no power would be wasted in transmitting current. In addition, a very small voltage would be sufficient to send heavy currents through a wire. On account of the resistance of a wire being governed by its geometrical dimensions, certain rules have been adopted by means of which the resistance of copper wires of any length or cross sections can be readily calculated. The basis which can be employed is the resistance of one foot of copper wire, one one-thousandth of an inch in diameter, commonly called a milfoot, which has a resistance of a little less than 11 ohms. The term mil is employed because it means a thousandth of an inch, or a thousandth part, and refers in this case to a round wire of the diameter above mentioned. If two such wires are placed side by side the resistance is reduced to one-half, three such wires will reduce it to one-third, etc. In other words, a rule may be stated as follows:

Rule.—The resistance of a wire of fixed length is inversely proportional to its cross section.

It is customary to call a wire of one mil diameter a circular mil; a wire of two mils diameter would therefore have four

circular mils; a wire of three mils diameter, nine circular mils, etc.

Table showing relation between resistance and cross section.

Circular mils.	Ohms.	Feet.
10,000	1.0	1,000
20,000	.5	"
30,000	.3333	"
40,000	.2500	"
50,000	.2000	"

It is not necessary to show how the resistance increases or diminishes as the wire increases or diminishes in length, while retaining the same cross section in circular mils, because it is obvious that a current must move through twice as much resistance in 1,000 feet of wire as 500 feet of the same cross section. As a proof of this fact the drop of potential with a given current in a fixed cross section is just twice as great with twice the length of wire, but as drop of potential equals C × R it is evident that if the current remains constant the drop in both can only increase or double if the resistance doubles.

A simple and practical rule can be deduced from these facts which will assume the following form:

Rule.—The resistance of a wire is proportional to its length in feet and inversely proportional to its cross section in circular mils.

Table showing relation between resistance, cross section and length.

Circular mils.	Ohms.	Feet.
10,400	10	10,000
5,200	"	5,000
2,600	"	2,500
1,300	"	1,250
650	"	625

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

A SCHEME TO PREVENT THE OIL FROM BEING THROWN FROM A DYNAMO BEARING.

We have had some trouble with one of our machines throwing oil up on the commutator. We maintained the oil level in the bearings as low as we dared, but some of the oil would come out. As you are aware, there is a groove cut into the shaft, which is supposed to keep the oil from running out along the shaft. These grooves are cut into the shaft in the manner shown in Fig. 1. I beveled off the side next to the commutator as per Fig. 2, and have had no more trouble with oil.

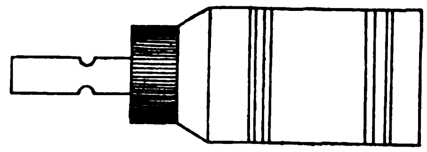


FIG. 1

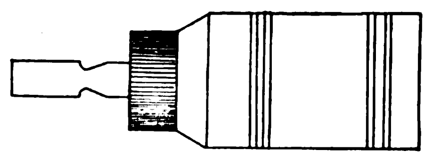


FIG. 2

The reason of this is that the oil tends to climb the high side; it will therefore stay in the bearing where it will do some good.

C. G. KNODE, Long Branch, N. J.

A HOME-MADE TRAVELING CRANE.

A great many of the smaller and older stations are not fortunate enough to have a traveling crane in the plant and have to resort to all kinds of makeshifts in order to do heavy lifting, which is bound to occur along with repair work. A cheap and quite satisfactory arrangement can be made use of as follows:

Out of 8-inch by 10-inch pine timbers make two (A) frames which fit snugly into an extra heavy 12-inch I-beam, as shown in the accompanying sketch.

By referring to the sketch it will be seen that the strain at the beam is mostly one of compression along the length of the beam. Bolts are passed through both timbers above and below the I-beam, and substantial cross pieces are fastened diagonally across the two legs to add stiffness. A heavy timber is notched out near each end to keep the legs from spreading, and bolts are run through the ends of the bottom beam to prevent any tendency of shearing of the end pieces.

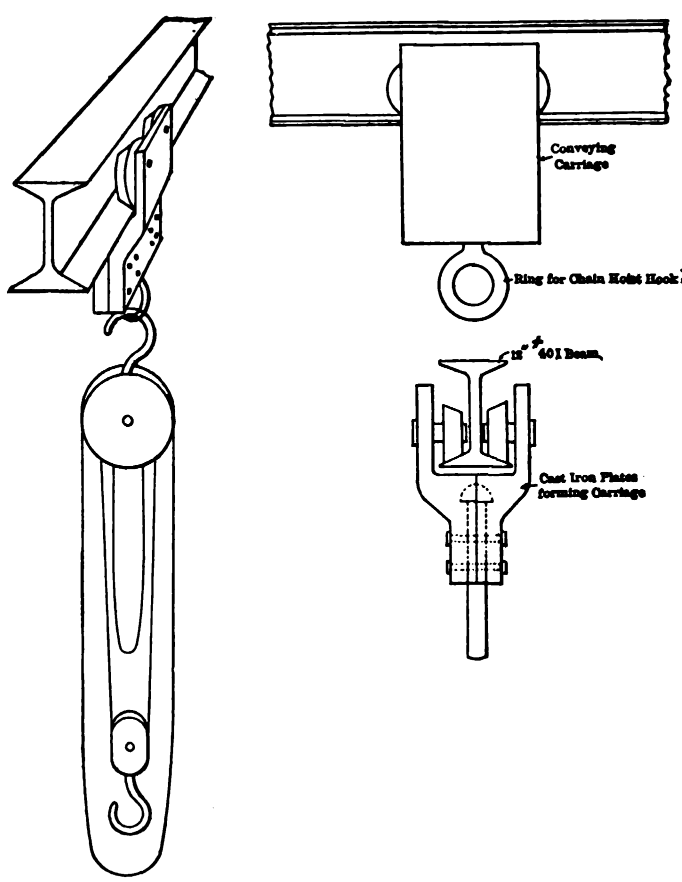
A carriage made up of four wheels with faces beveled off to fit the flange of the I-beam distributes the weight to be carried over the face of the flanges.

The hook block, which is below the I-beam, has two stiff cast-iron plates running up to carry the pins on which the wheels revolve.

A heavy chain block, fastened into the hook, completes the arrangement, which is of sufficient capacity to pick up any weight that the average station is called upon to handle.

The crane can be set up easily by four men in half a day and when not in use can be readily taken apart and stored away.

A 20-foot, 12-inch I-beam, weighing 40 pounds per foot, costs $24, and the carriage can be built at any machine shop



DETAILS OF TRAVELING CRANE.

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

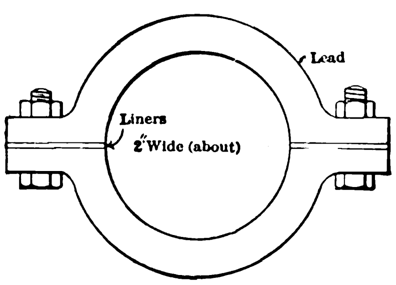
for $30, while a 5-ton hoist of 12-feet lift will cost $85.

With this arrangement a piece of apparatus can be picked up and moved along the length of the I-beam 15 to 18 feet in a very short time.

B. C. Adams, Madison, Wis.

TRUING ENGINE PINS.

In operating an engine the crank pins, cross-head pins and the pins in the valve gear have a tendency to wear flat, even with the best of care, and the difficulty of having a quietly running engine with cool pins can frequently be traced to this cause. Some engineers file their pins and smooth them up, but this requires a very skilled man and is a long and tedious operation. Returning the pins in place is difficult, and has the disadvantage of materially reducing the size of the pin, as the tool must go under the hard skin to make a perfect cut.



Lap for Truing Engine Pins.

We have adopted the practice of lapping pins that have become flattened. The process is simple, quick, and leaves a smooth and perfect pin.

The lap is of lead or of cast-iron faced with lead and is made in halves with liners, similar to an eccentric strap. The faces of the two halves should be fitted together nicely and the lap be bored to the size of the pin to be lapped, with the liners slotted so as to facilitate their removal without taking out the bolts. For a pin 6 inches long the lap should be 2 inches wide, and should be allowed to move from end to end of the pin. It is made narrow to avoid requiring too much power to work it. In operating the lap the lead is well supplied with emery and oil, clamped on the pin and rotated back and forth, at the same time being moved across the pin at each rotation, as holding continuously in one place has the tendency to make the pin wiry. We have lapped a 7-inch pin, 11 inches long, that was one-thirty-second of an inch out of round, fitted the brasses, and been running again in eight hours. This on a very hard nickel-steel pin. We believe this is as quick as the work could be done with a machine, and there was much less reduction in size than would have been possible had the pin been turned, filed or chipped. During the process, of course, the oil holes are carefully stopped and the emery carefully wiped off. We have found absolutely no bad effects in running after the use of emery powder.

A. Gartley, Honolulu, Hawaii.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE V.

BY W. H. WAKEMAN.

The next formulas to receive attention in these chapters are those based on rules and regulations adopted by the U. S. Board of Supervising Inspectors. Comments made on the condensed rule or formula usually given for this purpose, show conclusively, not that the rule is defective, but that those who criticise it are not familiar with all of the provisions on which it is based.

If the opinion of an expert, or any earnest and intelligent student or worker along this line, differs from those put forth by these inspectors, it is entitled to consideration and investigation, after which every reader has the right to form his own opinion, but when these comments show lack of full information on the subject, they are not to be valued above the conclusions of men who have enjoyed exceptionally good opportunities to apply scientific tests, have improved these chances to gain information and published the conclusions reached.

In order to properly present this matter it is necessary to give details of formulas and rules covering the points at issue, but they will be condensed as much as possible.

Formula No. 21 for steel and iron boilers with single riveted longitudinal seams:

$$\frac{(S \div 6) \times T}{R} = P.$$

S = tensile strength of plate in pounds.
T = thickness in inches.
R = radius of boiler.
P = safe working pressure.

In this case the difference between steel and iron boilers is accounted for by changing the value of S to suit conditions.

Applying this formula to a steel boiler of dimensions already given results as follows:

$$\frac{(60{,}000 \div 6) \times .5}{36} = 139 \text{ pounds.}$$

When it is used for an iron boiler the safe working pressure is less:

$$\frac{(50{,}000 \div 6) \times .5}{36} = 115.8 \text{ pounds.}$$

As these boilers are nearly always double riveted a formula that takes this feature into account is much used.

Formula No. 22, for steel and iron boilers with double riveted longitudinal seams:

$$\left(\frac{(S \div 6) \times T}{R}\right) \times 1.2 = P.$$

Applying it to a steel boiler results as follows:

$$\left(\frac{(60{,}000 \div 6) \times .5}{36}\right) \times 1.2 = 166.8 \text{ pounds.}$$

When applied to an iron boiler the pressure is less as before:

$$\left(\frac{(50{,}000 \div 6) \times .5}{36}\right) \times 1.2 = 138.96 \text{ pounds.}$$

When formula No. 22 is put into the form of a rule it reads as follows: Multiply one-sixth of the tensile strength of plate by its thickness in inches and divide by the radius of boiler. For double riveted seams add 20 per cent.

If the last sentence is omitted it applies to single riveted seams as per formula No. 21. Multiplying by 1.2 is equal to adding 20 per cent.

The absence of any mention of the strength of riveted seams in these formulas is prominent, and comment is sometimes made on this feature. One of our best engineers' pocket-books contains the following lines, quoted from a paper prepared by an expert.

"The rule ignores the riveting except that it distinguishes between single and double, giving the latter 20 per cent. advantage; the circumferential riveting or class of seam is altogether ignored. The rule takes no account of workmanship or method adopted of constructing the joints. The factor one-sixth simply covers the actual nominal factor of safety as well as the loss of strength at the joint, no matter what its percentage; we may, therefore, dismiss it as unsatisfactory."

It is not necessary to take the circumferential seams into account because even on a plain cylinder boiler without braces the strain on these seams is only one-half of that on the longitudinal seams, and in the case of ordinary tubular boilers the tubes and braces relieve the circular seams of much strain, thus lowering it still further. When this is considered we see that any kind of a seam worthy of the name, is more than sufficient for these places.

Furthermore, the U. S. Statutes inform us that these formulas give pressures that will only be allowed when all rivet holes are drilled fair, and in order to secure the 20 per cent. addition mentioned the seams must be double riveted.

It is practically impossible to lay out rivet holes in a flat sheet, drill them and have them come fair when the sheet is

rolled, therefore the statute virtually says that the holes must not only be drilled, but drilled in place.

Other provisions made are to the effect that all other parts of the boiler in question shall be made strong enough to stand the pressure above given, and no split caulking will be allowed.

Allowances are made for reduced strength at seams in the following formulas.

Formula No. 23 for steel and iron boilers with single riveted longitudinal seams:

$$\frac{S \times T \times .56}{R} = P.$$

S = tensile strength of plate.
T = thickness of plate.
R = radius of boiler.
P = bursting pressure.

Applying this to the steel boiler we are considering, results as follows:

$$\frac{60{,}000 \times .5 \times .56}{36} = 466 \text{ pounds.}$$

If a boiler of the same dimensions was made of iron the bursting pressure would be less.

$$\frac{50{,}000 \times .5 \times .56}{36} = 389 \text{ pounds.}$$

Another formula for a single riveted boiler gives the same results.

Formula No. 24:

$$\frac{S \times T \times 1.12}{D} = P.$$

S = tensile strength of plate.
T = thickness of plate.
D = diameter of boiler.
P = bursting pressure.

Applying this to the steel boiler determines the bursting pressure:

$$\frac{60{,}000 \times .5 \times 1.12}{72} = 466 \text{ pounds.}$$

For an iron boiler it gives a lower pressure because the tensile strength of plate is less:

$$\frac{50{,}000 \times .5 \times 1.12}{72} = 389 \text{ pounds.}$$

Formula No. 25 for steel and iron boilers with double riveted longitudinal seams:

$$\frac{S \times T \times .70}{R} = P.$$

S = tensile strength of plate.
T = thickness of plate.
R = radius of boiler.
P = bursting pressure.

When applied to the steel boiler the bursting pressure is found to be higher because the joint is stronger:

$$\frac{60{,}000 \times .5 \times .70}{36} = 583 \text{ pounds.}$$

Using it for the iron boiler gives the following result:

$$\frac{50{,}000 \times .5 \times .70}{36} = 486 \text{ pounds.}$$

The next formula may also be applied to both steel and iron boilers with double riveted longitudinal seams, if it is preferred to the preceding.

Formula No. 26:

$$\frac{S \times T \times 1.4}{D} = P.$$

S = tensile strength of plate.
T = thickness of plate.
D = diameter of boiler.
P = bursting pressure.

For a steel boiler:

$$\frac{60{,}000 \times .5 \times 1.4}{72} = 583 \text{ pounds.}$$

For an iron boiler:

$$\frac{50{,}000 \times .5 \times 1.4}{72} = 486 \text{ pounds.}$$

These formulas show that the strength of riveted joint is taken into consideration, but it may be claimed that it is done in a very rough way, as all single riveted seams are valued at .56 of the strength of solid plate and all seams with two rows of rivets at .70 of it.

In reply to this it may be stated that although all seams of the same type do not possess the same strength, yet if the instructions laid down by the U. S. Statutes, and rules adopted by the Supervising Inspectors are complied with, almost every joint will equal this strength, and many will exceed it, therefore little or no risk is incurred by using these formulas where all conditions are complied with.

John Fehrenbatch, M. E., who was a member of the Board of Supervising Inspectors for thirteen years, says that "the student can select either of the foregoing rules with perfect safety and with the assurance that each is absolutely correct." These formulas have been carefully adapted from the rules referred to and are the same in every respect, except that they are condensed so as to occupy less space.

Electric Power Looms.

The adaptability of electricity is exemplified in some of the French and German manufacturing towns, says the *Electrical Engineer*, London, where most of the work is done at home. In Lyons, a silk-weaving center, for instance, an electric distribution scheme was begun in 1895, and some 500 looms are now supplied. For $15.62 a loom is provided with power and light about 11½ hours per day all the year. At St. Etienne electric driving has been utilized to a still larger extent for ribbon work. The charge for current is $18.75 per year, and the rental for the motor 20 cents per month. In 1901 some 3,100 weavers with a total of 7,000 looms were supplied with current. In the parish of Anrath, near Krefeld, Germany, a ribbon-weaving district, an electric supply company now supplies light and power to about 1,000 house workers.

SINGLE VS. POLYPHASE GENERATORS IN ALTERNATING CURRENT RAILWAY WORK.*

BY W. A. BLANCK.

The present great interest in the development of alternating current railways makes most timely some considerations as to the selection of the generators delivering the energy to the system, particularly the choice between single and polyphase machines.

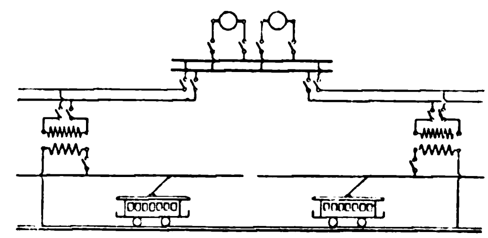


FIG. 1.

If the road to be equipped with the alternating current system takes its current from a power house in which polyphase apparatus is already installed, it would be natural to supply the various sections of the line from the different phases of the generators. In case of an entirely new installation, single-phase generators may be more advantageous than polyphase ones, notwithstanding the greater cost of the single-phase as compared with the polyphase generator of equal capacity.

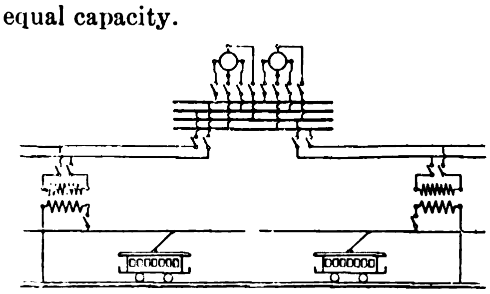


FIG. 2.

For the purpose of discussion, three typical cases have been chosen, shown by Figs. 1, 2 and 3. In each case 20,000 volt generators are assumed to feed directly on to the high tension 'bus bars, thus simplifying the diagrams by the omission of step-up transformers. High tension switches connect the 'bus bars to the transmission lines leading to sub-stations. In the sub-stations are installed

*From the "Electrician," London.

the step-down transformers with primaries connected to the transmission line by high-tension switches. Single-pole switches are inserted between one side of the 3,000 volt secondaries and the trolley wire, while the other side and the transformer case are connected to the rails. The power house is located at the center of the line, which is divided into sections

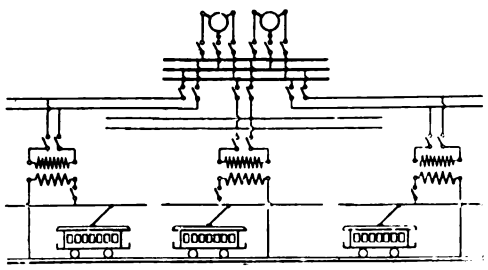


FIG. 3.

as the case may determine. These sections are separated by suitable insulators, and arrangements are provided for readily connecting them by jumpers in case of emergency. A simplification of these cases, obtained by using the rail as a common return for both primary and secondary circuits, is shown in the corresponding diagrams (1A, 2A and 3A). It will be noted that, in case this is done with the three-phase generators, 34,000 volts must be delivered to the 'bus bars in order to maintain 20,000 volts between the transmission line and the grounded neutral.

In case 1, using a single-phase system, it is necessary to install double-pole switches on the transmission line both in the power house and sub-station. Normally, the static strain between the transmission line and ground will be half of the impressed voltage. In case 1A with a

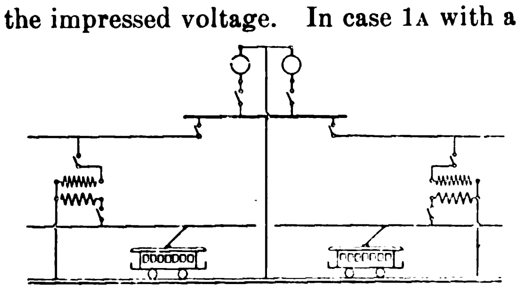


FIG. 1A.

single transmission line, it is only necessary to use single-pole switches in all primary circuits, thus effecting a very material saving in the expense of high tension switches as well as the saving of 50 per cent. in transmission line copper and insulators. It will be noted that this arrangement subjects the transmission system and transformers to the full static strain of the impressed voltage. This will call for somewhat greater care in insulation of the transformers, and will continuously subject the insulators of the transmission line to a higher strain. The decreased number of insulators with the corresponding decrease in points at which failure can occur, however, tends to counterbalance the somewhat more rigorous requirements. Should it transpire that one line is grounded in case 1, the system can still be operated until repairs can be made, while in case 1A such a failure would necessitate the shutting down of that particular transmission line. This condition, however, is exactly analogous to that of a three-phase system with a grounded neutral, now so generally used.

When the system depicted in Fig. 1 is in normal operation, the adjacent sections are at the same potential and the section insulators are subjected to no strain whatsoever, while if one section is shut down the insulator will have to withstand the full trolley potential of 3,000 volts.

Should any one section of the transmission line, or any one sub-station be put out of commission, it is possible, by using the jumpers mentioned, to feed the disabled trolley section from each of the adjacent sections, thus maintaining ser-

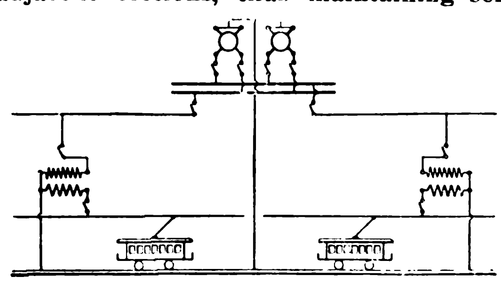


FIG. 2A.

vice without excessive drop. A very important feature in the operation of this system is the fact that the full generator capacity is available at any point on the system, thus making it possible to take care of any unbalance in the distribution of the load, due to congestion of traffic at any point of the system.

In case 2 the use of two-phase generators is considered. This will be more advantageous when applied to a system consisting of a single line with the power house located at the center. Current will be supplied to one end of the system from one phase of the generators, while the second phase feeds the other end.

In comparing the cases 2 and 2A, the conditions are exactly similar to 1 and 1A, so far as the saving in switches, copper, and insulators and the static strains are concerned. A noticeable difference exists, however, so far as operation is concerned. Since the adjacent sections are fed by different phases, the section-insulator must stand 4,200 volts when in normal operation. In case one section of the transmitting system is disabled, current can be supplied by means of jumpers only from the adjacent sections supplied by the same phase, which will result in double the drop due to a similar occurrence in case 1. Since the section of the system fed by the different phases must be entirely separated, this arrangement does not provide for an unbalance in load so well as in case 1. In fact, only 50 per cent. of the generator capacity is available on either section, a point of considerable importance in practical operation.

In case 3 the application of three-phase generators to the single-phase system is considered. This arrangement is best

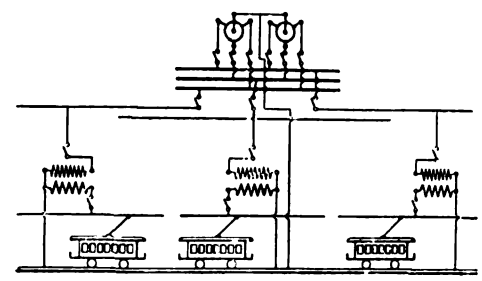


FIG. 3A.

adapted to a railroad system consisting of main line and branches with the power house located at the junction since it will then be possible to feed the sections without necessitating the overlapping of the transmission lines. Again, similar relations hold between 3 and 3A as between 1 and 1A so far as the saving in switches, copper, and insulators and the static strains are concerned.

The insulators separating sections fed by different phases have to withstand 5,200 volts as compared with the 4,200 volts in case 2. The same limitation in feeding any section of the trolley from its adjacent section in case of a disabled transmission line hold as in case 2. So far as available generator capacity for any section is concerned, the two cases are materially different. In case 3, due to the delta connection, it is possible to utilize 66 per cent. of the generator capacity on any section, whereas in case 3A with star connection, only 33 per cent. of the generator capacity is available on any one section.

It is evident that on account of the high potentials, section insulators must be of considerably greater length than those now used on low voltage trolleys, approximately from 4 feet to 6 feet in length. This will have a very appreciable effect on the lights when the car passes the section insulator, as well as presenting difficulties in starting which would arise should the car come to rest under the insulator. Moreover, the arcing due to the interruption of the current of high voltage is apt to prove serious. All of these difficulties can be overcome in case 1 by the use of two trolley bows one mounted over each end of the car

Since these will more than span the section insulator, the current will not be interrupted, thus materially improving the operation of the system.

This arrangement with the two bows can only be applied in case 1, as in cases 2 and 3 it would not be permissible to short-circuit two sections fed by different phases, which leaves the latter cases subject to the difficulties mentioned above.

A metallic circuit telephone system installed on the same poles as the grounded high tension line will be subjected to higher static strains and greater inductive actions than in the case of the ordinary transmission line. The effect of induction can be overcome by frequent transposition of the telephone wires. To guard against shocks due to static strains, care must be taken to provide perfect insulation for the telephone instruments as well as for the person using the telephone.

From the foregoing discussion, it appears that it will be entirely possible to use two and three-phase generators now installed to furnish power for single-phase systems, but that the difference in potential between sections and the small generator capacity available on any section are serious obstacles to the satisfactory operation with this arrangement.

Where entirely new apparatus is to be installed, it is undoubtedly better to use single-phase generators. Their first cost is somewhat greater, but the system is far more flexible in its ability to handle unbalanced load conditions, and with the double-bow trolley gives perfectly continuous service under section insulators.

While the suggestion to use the rail as common return for both high tension and trolley circuits is a radical departure from current practice, it does not involve greater risks with regard to personal safety or the continuity of the service than in the ordinary three-phase system with grounded neutral.

REPORT OF THE COMMITTEE ON PROGRESS.*

BY T. COMMERFORD MARTIN.

(*Continued from page 317.*)

THE OSMIUM LAMP.

A great many inquiries have reached me during the year as to the osmium-filament lamp and its availability. So far as I know, none are in regular use in this country, but they are obtainable and in service abroad. The subject is certainly an interesting one, and I have collated a little data. As to the manufacture of the filaments, it has been found possible to produce suitable osmium wires by bringing the osmium in a finely-divided state, mixed with a carrier or binder, into the form of a wire. The wire thus formed is treated in the electric furnace by heating it by means of the current to a high temperature, above that of the vaporization point of platinum. The binding material is thereby destroyed and the individual osmium particles are welded together. The heating of the osmium wire must be carried only to a point at which it still remains finely porous, as dense wires are liable to break in the lamp. The manufacture of a filament consisting of an osmium-platinum alloy is carried out by heating a thin platinum wire by the current in a reducing atmosphere, which must contain hydrocarbons, a considerable amount of water vapor and vapors of perosmic acid. Metallic osmium will separate on the platinum wire, which is then heated above the vaporization point of the platinum. The residual filament is an elastic tube, consisting mainly of osmium, but still containing some platinum. The manufacture of osmium-carbon filaments is also feasible, and filaments including a mixture of thorium or zirconium oxide. In a test made by the German Reichsanstalt of 38-volt osmium lamps during 600 hours, it was found that the consumption of current of the 30 and 35 cp. lamps was 1.28 amperes, so that the consumption of power is 1.43 to 1.58 watts per candle of average illumination perpendicular to the axis of the lamp. A considerable decrease of the candle-power during the 600 hours was not observed. Other tests were made by Wedding, who found that the osmium lamp when suspended vertically consumed 1.4 watts per candle against 2.5 to 3.5 watts with the carbon-filament lamp. The absolute life of the lamp is far beyond 1,000 hours.

Although one lamp was destroyed after 520 hours, the others which were tested had an absolute life of more than 3,320 hours. The higher the candle-power, the longer the absolute life. The "net" life of a lamp is the time in which the candle-power is reduced to 20 per cent. of its original value; none of the tested lamps decreased its candle-power to such a degree before the filament was destroyed. This means in practice a considerable advantage over carbon-filament lamps. While the latter lose candle-power on account of the blackening of the globe, the osmium lamps remain clear and decrease in candle-power much more slowly. An auxiliary apparatus for introducing the osmium lamp has been placed on the market under the name of "divisor." This is a device for dividing the voltage into several equal parts, and is to be used where the lamps are not to be worked in series, but independently of each other. It is a transformer with a single winding, divided, for instance, in three equal parts.

When its terminals are connected to a voltage of the network equal to 120 volts, this voltage is divided into 3 x 40 volts. This enables one to supply three circuits of osmium lamps independently of one another. The advantages of this device over an ordinary transformer are higher efficiency and smaller cost. The manufacturer is making two types of these devices, one for 3 x 2 and one for 3 x 10 lamps.

The range of voltages for which the lamps may be used has recently been increased, and lamps for 55 volts are now supplied by the Austrian Gasgluehlicht and Elek. Gesellschaft of Vienna. From a report of Wedding it appears that two groups, each consisting of six lamps, of 37 volts, were tested in series across 220-volt supply mains. In one of the groups for the first 3,132 hours, the average life of the six lamps was 2,853 hours, and the average candle-power fell from 30.1 to 23.7, the mean consumption in watts per candle-power rising from 1.46 to 1.78. After 520 hours the first lamp collapsed, and after 3,724 and 3,940 hours, respectively, two others gave way, the remaining three still burning after 3,973 hours. For the second group, which consisted of six 25 cp. lamps, the average life was 1,479 hours, the candle-power dropping in 2,198 hours from 25.1 to 19.9 and the energy consumption increasing from 1.37 to 1.75 watts per candle-power. The filament of the lamp si smade up of two loops, which are held apart by insulating stays or anchors attached to the interior of the glass bulb. The use of the lamp in train lighting is also to be noted, namely, on the Marienburg-Mlawka Railroad in Germany, in place of carbon-filament lamps. The current is derived from storage batteries carried on the train. As the incandescent carbon lamps formerly used were not very durable and showed a diminution of their lighting power toward the end of their life, osmium lamps were substituted at the beginning of August, 1902. They gave 10 cp. at 16 volts, and the calculated energy consumption was 1.5 watts per candle-power. The storage batteries then required recharging after 72 hours, whereas with the old lamps they had to be recharged after 32 hours, the final voltage being in both cases the same. After burning 750 hours, no diminution in the light could be observed in the

*Abstract of report read before the National Electric Light Association at its 27th Convention, held at Boston, Mass., May 24-27, 1904.

osmium lamps, the bulbs of which kept perfectly clear while those of the carbon lamps had blackened. The vibration of the trains does not affect the lamps. For the ordinary incandescent lamp, with an average life of from 300 to 400 hours, 22.5 cents were paid; for the osmium lamp, with an average life of 1,000 hours, the cost, it is stated, was $1.19; the cost for depreciation was, therefore, 0.056 cent for the old lamp and 1.119 cents for the osmium lamp.

It would appear that the European commercial lamps are sold for 16 volts at 10 and 16 candles, 25 to 30 volts at 25 candles, 27.5 volts at 16 and 25 candles, 32 to 44 volts at 25 to 32 candles. The supply of osmium is small, and the price of the lamp is, therefore, high, namely; $1.25; 19 cents are given back if the burned-out but unopened lamp is returned within 18 months. The filament of such a lamp can be treated and used again.

SOME NEWER LAMPS.

One of the promised novelties is a new direct-current arc lamp in the hands of the General Electric Company, about which not many details have yet been given out. It is known as the "Magnetite" lamp. The negative electrode in the lamp is a stick of magnetite, while the positive electrode is a copper block, which is practically without wear. The stick of magnetite is five-eighths inch in diameter and 8 inches in length, and burns for 150 hours without the necessity of an inner globe, as in the inclosed arc. The production of light for 300 watts is put down as equal to that of the ordinary arc at 450 watts. The lamp would appear to have advantages for street work, but is apparently not adapted for indoor service, on account of the smoky deposit.

In connection with this lamp Mr. Charles P. Steinmetz, who has been giving special attention to the subject, says: "In the case of the magnetite arc lamp only the negative or lower electrode consists of magnetite, and is consumed. The positive terminal is not replaced, but is a copper segment, which constitutes a permanent part of the lamp. The metals of the iron group yield a brilliant arc flame of very high efficiency and white color. To give a long life the metals which are combustible are not well suited, but a stable oxide of these metals must be used; that is, a compound which cannot burn any more. Amongst the conducting oxides, magnetite fulfills best the requirements of a carrier of the arc flame, since it is well conducting, stable at all temperatures, very plentiful in nature, and gives a white arc of high efficiency. Pure magnetite, however, is not quite satisfactory, since its efficiency is not very high, hardly twice as high as that of the ordinary carbon arc, and the arc tends to flicker and the rate of consumption of the electrode is rather high; as high as one-eighth inch per hour. This, while very much lower than the rate of consumption of flame carbons, of 1 inch to 2 inches per hour, would still give only 50 to 60 hours' life with the standard size of electrode adopted for the magnetite arc lamp, of 8 inches length. Therefore, with the magnetite as carrier of the arc flame are incorporated other substances in small quantities as arc-steadying compounds—titanium compounds for increasing the efficiency, etc.

"In the manufacture of these magnetite arc electrodes, by partially reducing the material to metal, a greater density is produced and so a greater amount of material with the same size of electrode, which gives a longer life. Such partial reduction, however, has the disadvantage that when not carried far enough it leaves the electrode porous and of relatively short life, while when carried too far, the light tends to unsteadiness, turns faint and blue whenever the arc strikes metal, and in this case scintillating sparks are thrown off, which may crack the outer lamp globe. A much better method of producing electrodes was found by not reducing the material, but adding a restrainer; that is, a substance which added to the electrode material in small quantities reduces the rate of consumption. Hereby, without any loss of efficiency, rates of consumption of 20 to 30 hours per inch are produced, which give a life of 150 to 200 hours for the eight-inch electrode. With very little sacrifice of efficiency a life of 500 to 600 hours is produced, and such an electrode has about the same life as an incandescent lamp; that is, the arc lamp requires trimming about as often as an incandescent lamp requires renewal. This latter feature, however, while obviously valuable in cases where trimming is difficult, as with lamps in inaccessible places or during protracted strikes, etc., for general illumination is hardly needed, since it would in street lighting give a life of two months, and a street lamp should be looked after oftener than this.

"A simple and satisfactory form is an electrode in which the material is compressed as impalpable powder in a thin iron tube, which is then sealed over by the arc. In the carbon arc lamp the light comes from the incandescent crater of the positive carbon and not from the arc flame. Hence, the arc lengths should be made as short as possible without obstructing the escape of light from the crater. In the magnetite arc, however, no light issues from the terminals, but all the light comes from the arc flame, and an arc length from three-fourths to one and one-eighth inches is, therefore, most efficient. Furthermore, to give a constant volume of light the arc lengths should be constant. This leads to a feeding mechanism differing from the 'floating system' of the carbon arc lamp and much simpler; that is, a feeding device maintaining constant arc length. The operation of the magnetite arc lamp is, therefore, as follows: When the power is put on the lamp, the arc is struck by separating the electrodes to a definite distance, say seven-eighths inch, and then the electrodes are locked in this position and remain fixed until after some hours or so, by the consumption of the negative electrode, the arc length and thereby the arc voltage has increased sufficiently to operate the feeding mechanism which resets the arc to its original length."

(*To be continued.*)

BOOKS RECEIVED.

ELECTRICITY AND MATTER. By J. J. THOMSON, D.Sc., LL.D., Ph.D., F.R.S. Published by Charles Scribner's Sons, New York. 162 pages. Price $1.25.

When we peer into the invisible world by means of the utensils supplied by science a startling scene presents itself. The molecule becomes a universe and the atom a great constellation. We realize that the knowledge stored in our minds by the academic schools is useless.

Gravitation seems replaced by electric attraction and our old-fashioned ideas of matter become vague and meaningless images. In the volume entitled "Electricity and Matter," by J. J. Thomson, we are brought to the threshold of a new philosophy. We begin to realize that chemical affinity is electrical attraction, that valency finds its explanation in the same force and the atom and its marvelous constitution can only be consistently explained on this new basis. We see the corpuscle of matter with its electric charge producing the long list of chemical substances so familiar to us and we begin to wonder with the author whether this dividing line between the corpuscle of matter and the electric charge does not disappear and the two become identical. That seems to be the trend of modern scientific thought so well outlined in the pages of this valua-

ble book—that energy, force, matter, all are one.

CARE AND HANDLING OF ELECTRIC PLANTS. By NORMAN H. SCHNEIDER. Published by Spon & Chamberlain, 123 Liberty street, New York. 105 pages. Illustrated. Price $1.

The object of this book, which is gotten up attractively in pocket form, is fully explained by the author in the preface. He states that it is intended as a handbook of practical information for those who are called upon to operate a commercial or military electric light plant without having had previous experience. It is written with the aid of notes actually obtained in handling the apparatus described, the chapter on incandescent lamps being especially notable.

The book certainly contains a large amount of information and data that cannot help but be of value to an ambitious man in a central station.

Marconi Arrives on Campania.

The complete success of the first ocean daily newspaper and the maintaining of wireless communication with both shores of the Atlantic for three days was the news brought by Signor Marconi, arriving in New York Saturday on the Campania.

Two days out of Liverpool communitions with both shores were established; from Cape Breton, Canada, 2,000 miles west, and Poldhu, Wales, 845 miles east. Throughout the voyage these communications continued unbroken and unhindered by passing ships, until the 8th, when Poldhu, 2,050 miles east, was dropped.

It was on June 7 that the first mid-ocean Marconi newspaper was published.

Already the Marconi Company has arranged to receive market quotations from the United States and England. As soon as the powerful transmitter is installed each ship will be equipped with larger offices for the reception of telegrams to the shore. Such messages will be sent hourly.

Graduates Quickly Placed.

Prof. Geo. D. Shephardson writes us that nearly all of the class graduating from the electrical engineering course at the University of Minnesota are located, many of them being at work already. E. J. Cheney, V. E. Goodwin and F. C. Helms enter the engineering apprentice course with the General Electric Company of Schenectady; J. Howatt, F. A. Otto and R. B. Taplin enter the engineering apprentice course of the Westinghouse Electric & Manufacturing Company at Pittsburg; L. C. Tomlinson and J. Wicks go with the Automatic Electric Company at Chicago; G. Crabbe goes with the Otis Elevator Company at Yonkers; H. G. Morton goes with the Northwestern Telephone Exchange Company at Minneapolis; B. M. Bouman will enter the telephone field, and P. M. Rosok goes with the Missouri River Power Company at Helena.

Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society, for the election of officers, will take place—by courtesy of the officers of the Electrical Testing Laboratories—at 80th street and East End avenue, New York City, this evening, June 15, at 8 o'clock. The visitors will be welcomed by Mr. John W. Lieb, Jr., president of the Laboratories, and addresses will be given by Mr. Wilson S. Howell, manager, and Dr. Clayton H. Sharp, test officer. After an inspection of the various departments of the Laboratories a collation will be served.

Inventor Esmond Killed by a Fall.

Frederick C. Esmond, an electrical engineer and inventor, who lived at Richmond Hill, Long Island, was killed June 11 by falling from the roof of the front porch of his home. Mr. Esmond was 50 years old, and had traveled extensively in different parts of the world. One of his inventions was an appliance for trolley cars.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 7, 1904

Electric Railways and Appliances.

761,637. Trolley-Guard. Linwood B. Aikens, Rockledge, Fla. Filed March 24, 1904.

761,694. Electric-Railway System. Charles H. Murphy, Scranton, Pa., assignor of two-thirds to David B. Hand and George F. Garrity, Scranton, Pa. Filed Sept, 1, 1903.

761,848. Trolley-Signal. Charles H. Morse, Cambridge, Mass. Filed June 27, 1901.

761,853. Electric Railway-Signal. Robert J. Sheehy, New York City. Filed Sept. 9, 1902.

762,009. Automatic Block-Signaling System. Herbert B. Taylor, Newark, N. J. Filed Oct. 14, 1903.

762,105. Electric Semaphore Signaling System. Bruno O. Wagner, Amsterdam, N. Y., assignor to the Magneto Electric Company, Incorporated, same place. Filed May 12, 1903.

Electric Lights and Appliances

762,030. Incandescent Lamp. Samuel E. Doane, Cleveland, O., assignor to the National Electric Lamp Company, same place. Filed Dec. 12, 1903.

762,115-116. Electric-Arc Lamp. Malcolm H. Baker, Pittsburg, and Samuel P. Wilbur, Wilkinsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed Dec. 6 and Dec. 8, 1902.

762,215. Searchlight. William O. Webber, Boston, Mass. Filed Jan. 6, 1904.

Electrical Machinery and Apparatus.

761,675. Electric Cut-out. William J. Hartwig, Detroit, Mich. Filed Feb. 29, 1904.

761,743 Electric Switch for High Potentials. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Sept. 24, 1903.

761,744. Switch-Contact. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Oct. 14, 1903.

761,745. Switch for Electric Circuits. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Dec. 30, 1903.

761,748. Circuit-Breaker. John R. Anderson, Jr., Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Sept. 12, 1903.

761,776. Circuit-Breaker. William J. Lloyd, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Aug. 19, 1903.

761,876. Means for Reversing Electric Motors. Charles M. Clark, South Orange, N. J. Filed Dec. 10, 1902.

761,985. Rocker-Ring for Electrical Machines. Edson R. Norris, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 16, 1903.

762,034. Electric Switch for Motor-Carriages. Henry C. Folger, West Somerville, Mass., assignor to the American Coil Company, Boston, Mass. Filed Dec. 18, 1903.

762,141. Electric Machine. Niels A. Christensen, Milwaukee, Wis. Filed April 8, 1901.

762,186. Locking Mechanism for Electrically-Controlled Elevator Mechanisms. John S. Muckle, Philadelphia, Pa., assignor to the Standard Elevator Interlock Company, Philadelphia, Pa. Filed July 23, 1903.

762,204. Circuit-Breaker. Frank L. Sessions, Columbus, O., assignor to the Siemens & Halske Electric Company of America. Filed June 16, 1902.

Telephones and Telephone Apparatus

761,698. Telephone Switchboard Apparatus. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed Nov. 24, 1902.

761,852. Apparatus for Telephone Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company. Filed Aug. 17, 1895.

761,888. Telephone-Selecting Device. William M James, New Brighton, Minn. Filed June 25, 1903.

761,916. Protective Device for Telephone-Circuits. Malcolm C. Rorty, Boston, and George K. Thompson, Newton, Mass., assignors to the American Telephone & Telegraph Company. Filed Dec. 15, 1902.

761,995. Apparatus for Reducing Attenuation of Electrical Waves. Michael I. Pupin, New York City, assignor to the American Bell Telephone Company. Filed Feb. 6, 1903.

762,039. Antiseptic Attachment for Telephone-Mouthpieces. James Freel, Ladysmith, Canada. Filed Dec. 2, 1903.

Miscellaneous.

761,641. Exciting Fluid for Electrical Batteries. George F. Atwood, Wakefield, Mass., assignor to the Primary Power Company, same place. Filed Oct. 3, 1903.

761,760. Insulator. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Aug. 8, 1903.

761,814. Combined Insulator and Fuse-Box. Aaron Bearse, Syracuse, N. Y. Filed Aug. 26, 1903.

761,875. Overhead Electric Carrier. Charles M. Clark, South Orange, N. J. Filed Nov. 24 1902.

761,877. Insulating-Block for Electric Conductors. Charles M. Clark, South Orange, N. J. Filed July 7, 1903.

761,884. Telpher. Henry M. Harding, New York City Filed Dec. 3, 1902.

7 61,895. System of Electrical Distribution and Control. Lamar Lyndon, New York City, assignor, by mesne assignments, to the Electric Car Lighting Company, Jersey City, N. J. Original application filed July 18, 1903. Divided and this application filed Dec. 15 1903.

761,917. Telegraph-Transmitter. Willis J. Roussel, New Orleans La., assignor of one-eighth to Alphonse King, Chicago, Ill. Filed Feb. 11, 1903.

761 920. Electric Furnace. Charles P. E. Schneider, Le Creusot, France. Filed Oct. 12, 1903.

761,971. Apparatus for Generating Electricity. Andrew C. Kloman, Pittsburg, Pa. Filed Sept. 18, 1903.

762,083. Electric Musical Instrument. Emil A. Petching Lymansville, R. I. Filed Sept. 15, 1903.

762,111-112. Electrically Conductive Coil and Method of Constructing Same. Vincent G. Apple, Dayton, O. Filed Sept. 21, 1903.

762,114. Regulating Device for Electric Circuits. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 25, 1902.

762,125. Electrical Temperature-Alarm. Joseph P. Bolton, Fresno, Cal. Filed June 16, 1902.

762,227. Anode and Process of Making Same. Henry Blackman, New York City. Original application filed Dec. 8, 1896. Divided and this application filed April 24, 1903.

762,257. System of Distribution. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical & Manufacturing Company. Original application filed Dec. 11, 1901. Divided and this application filed Aug. 18, 1903.

THE TELEPHONE WORLD.

Texas Telephone Company to Spend $50,000.

At a recent meeting of the directors of the Grayson County Telephone Company, the matter of deciding upon the extent of improvements to the system in Denison and Sherman was left to a committee composed of J. C. Rorick, of Wauseon, O., and C. D. Crites, of Lima, O. These gentlemen held a consultation with C. A. Schock, manager for the company, with headquarters at Sherman, in the Denison office of the company, and decided to purchase $50,000 worth of material, which will be used in extensions and improvements in the two cities.

Fifty thousand feet of cable will be purchased and the lines extended to every portion of both cities, and the equipment will be renewed and improved wherever necessary. The work of improvement will commence as soon as the material can be purchased and shipped.

Messrs. Rorick and Crites expressed themselves as well pleased with the progress and growth of the telephone system in Denison and Sherman and particularly well pleased with the prosperous condition of North Texas and the possibilities of its resources.

An effort is being made by representatives of the telephone company to secure an increase in the number of its subscribers in Glastonbury, Conn. The canvass of residents in the Buckingham section has resulted in five additional subscribers. It is understood that the installation of the proposed telephone exchange for Glastonbury, which is not favored by the present subscribers, is dependent upon an increase of 40 subscribers, and it is with the view of obtaining this increased number that the company is now having a thorough canvass of the town.

A Home telephone company is being organized in Fayette, N. Y. The following officers have been named: President, Dr. McWayne; secretary, Fred Emens; treasurer, Charles O'Connor; director, Dr. A. J. Frantz. It is the purpose of the company to establish telephone connection with East Varick, Canoga, Romulus and other nearby points, which will prove a genuine convenience to all residents in that locality.

The connection of the Tri-State Telephone Company with the Pittsburg & Allegheny, Pa., Company, has been completed. The Tri-State had 2,000 telephones in Fayette County, and also has connections with all Green County and the principal towns of West Virginia.

A Maine organization known as the Casco Telephone Company, and capitalized at $10,000, has lately been incorporated with the following officers: President, Richard Cook; treasurer, H. G. Cook, both of Casco

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The Stamper's Creek & Orleans Telephone Company, of Orange County, Ind., is a new concern with Harry McCoy, Shelby Cornwell and Benjamin F. Williams as directors.

The Woodstock Telephone Company, of Pulaski County, Ky., has been formed with $1,000 capital stock.

Ohio Telephone Men Form Permanent Organization.

A permanent organization was recently effected in Columbus by the representatives of the Independent telephone companies of the State, under the title of the Ohio Independent Telephone Association. While this organization has been in existence for some time, yet it has been only temporary.

The State is divided into nine districts, according to the constitution of the association, by the executive committee appointed by the president. To this committee has been referred the plan for a co-operative insurance association for the Independent companies, and a report will be made at the next meeting.

Annual meetings will be held at Columbus some time in March. Memberships are confined to telephone companies rather than managers and superintendents.

Officers for the ensuing year were chosen: President, Frank L. Beam, Columbus; vice-president, W. Gilbert Thompson, Lebanon; G. P. Thorpe, Wilmington; J. B. Hoge, Cleveland; R. E. Hamblin, Toledo; James C. Reber, Dayton; Dwight E. Sapp, Mt. Vernon; George A. Mathany, Lima; W. F. Laubach; Akron; J. B. Rhodes, Zanesville; secretary, E. E. Knox, Portsmouth, and treasurer, Ralph Ramer, Columbus.

The Iola, Kan., Telephone Company has started in to spend $4,000 on its system. It will be spent largely in the stringing of cables and the installing of copper metallic circuits. The company will put in 1½ miles of cables and copper metallic wires. The wires which sustain the cables have been strung. When the cables are installed there will be 2½ miles of cables in Iola, and very few telephone wires that are not the copper metallic circuit variety.

The Anthracite Telephone Company, which recently was granted a franchise by the council of Forest City, Pa., is making preparations to install one of the most improved telephone systems in that borough. A canvass of the town for subscribers has convinced the company that the line will receive hearty support. The exchange will be equipped with a visual signal, central energy and supervisory lamp clearing out switchboard. Stromberg-Carlson apparatus will be used throughout.

The Wayne & Hammondsport, N. Y., telephone line is nearly completed, and the company has been incorporated. The line will be extended to Lake Keuka, which will accommodate several subscribers. A connection at both Wayne and Dundee will be made with the Interocean Company's lines. The line will be a metallic circuit, and when completed will be one of the best lines that is now in the Lake Keuka region.

The Watertown Telephone Company of Watertown, Minn., has an authorized capital stock of $25,000. Its officers are F. A. Barth, president; G. F. Peterson, vice-president; G. E. Halgren, secretary; R. J. Burke, treasurer.

The Wisconsin Telephone Company will build lines paralleling those of the Citizens' Telephone Company in Kenosha County.

Telephone Subscribers Incorporate.

News from Baltimore, Md., states that the Telephone Subscribers' Protective Association was lately incorporated by George W. Slater, Philip D. Tucker, Edwin S. Evans, William Lenz and John Stonewall Jackson Healy. It has no capital stock.

Mr. Healy says that the purpose of the new association is to bring about a readjustment of telephone rates and an improved service.

The Rensselaer N. Y., Telephone Company, which is soon to be known as the Commercial Telephone Company, is rapidly extending its line in Rensselaer County. Wires are being strung through the towns of Brunswick and Poestenkill, and already the company has installed connections with Cropseyville and Center Brunswick. The work of extending the lines through Greenbush will be inaugurated shortly and the company expects to be able to connect with Rensselaer before the end of the summer.

Articles incorporating the German Telephone Company, with principal office at Golden, Ill., have been filed by the Adams County Recorder. The purpose is to establish telephone lines between farmhouses. The capital stock is placed at $5,000, 200 shares at $25 each, and this stock is divided among a large number of farmers who will be benefited by the line. The directors of the company are Andrew Bartell, Menne Gronewald, John Gerches, D. G. Buss, Menne Aden, Frederick Franzen and Diedrich Fuhrken.

The Rural Telephone Company, of Hopkins County, Ky., has been incorporated with W. N. and W. B. Bailey and M. F. Allen as incorporporators. It will build numerous lines in that county for the benefit of the farmers and others who have no way of communication and will extend to Muhlenberg, and perhaps other counties.

The Odell Telephone Company, of Odell, Neb., has filed articles of incorporation with the Secretary of State. The capital stock is $10,000.

A franchise has been granted the Central Union Telephone Company to erect a telephone exchange in Granville, O.

The Maple Creek Telephone Company of Charleroi, Pa., has entered intered into a traffic agreement with the Federal Telephone Company.

The York, Pa., Telephone Company has declared its usual semi-annual dividend of 2 per cent., which will be payable July 1.

Telephone Incorporations.

The Eldorado & West Manchester Telephone Company, Greenville, O. Capital stock, $40,000.

The Reddick Mutual Telephone Company, Reddick, Ill. Capital stock, $5,000. Incorporators: James Reilly, I. G. McLain and William McGinnis.

The Conewango Valley Home Telephone Company, Forestville, N. Y. Capital stock, $11,000. Incorporators: A. H. Libby, Forestville; E. B. Crissey, Jamestown, and B. C. Wilson, South Dayton.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bay City, Mich.—The electric light commission recently appointed is considering the location of a municipal electric plant.

Belle Fourche, S. D.—The city council is figuring on granting an electric light franchise to S. A. Oliver.

Carrollton, Ga.—At a municipal election held here this month, the issuance of $45,000 worth of bonds was authorized to be used in constructing waterworks, sewerage and an electric light plant to be owned by the city.

Carleton, Mich.—A move is being made for an electric lighting plant.

Clinton, N. Y.—From the present outlook the time is not far distant when some action will be taken in regard to electric lights for this city.

Davenport, Ia.—An electric lighting plant is to be built at Campbell's Island.

Hampton, Neb.—Lloyd and Merle Dory have purchased the electric light plant here and have taken possession.

Hartford, Wis.—This town is soon to be lighted with electric lights.

Jacksonville, Fla.—The electric light plant here is to be improved.

Kirkwood, Ill.—Electricity will soon light the streets of this town.

Kissimmee, Fla.—An ordinance is to be introduced in the council in regard to bonding the town in the sum of $17,000; $7,000 for the better equipment and enlarging the capacity of the electric light plant.

Lancaster, Mo.—The city council has purchased a site for the municipal electric light plant.

Milwaukee, Wis.—Bonds to the amount of $150,000 will be issued here for a municipal electric lighting plant.

Oakland, Neb.—The city council has decided to call an election for June 21, to vote on the proposition to issue bonds to the amount of $7,000, for the purpose of putting in an electric lighting plant.

Ocilla, Ga.—J. B. McCrary, of Senoia, is preparing plans and specifications for an electric light plant for the town to be installed as soon as the contract has been let.

Osborne, Kan.—A franchise has been granted for an electric light plant here.

Oshkosh, Wis.—The Berlin Electric Lighting, Heating & Power Company will expend $18,000 in improvements.

Pauls Valley, I. T.—The electric light plant here was almost totally destroyed by a recent fire, but the loss is covered by insurance.

Penn Yan, N. Y.—Bids are being received for the new electric lighting plant here.

Philadelphia, Pa.—It is still claimed that plans are being worked out for the formation of an electric lighting company to compete with the Philadelphia Electric Company. The assertion also is made that the movement is backed by strong financial interests in both this city and New York.

Rotterdam Junction, N.Y.—This place is considering the installation of electric lights.

Springfield, Mass.—The Turners Falls Company has voted to increase its capital stock from $300,000 to $600,000. C. T. Crocker is president. The directors have decided to continue the work of improving the power, and build an electric light plant.

St. Joseph, Mo.—The citizens will vote in July on a proposition to issue $325,000 in bonds for a new electric light plant and for the extension of the sewerage system.

Waterloo, N. Y.—The committee of the village board on electric lighting has made a report, as a result of a visit to Geneva to inspect the inclosed arc and series incandescent system in use there, favoring the adoption of a similar system here.

Wimbledon, N. D.—The electric light plant here, which has been unused for some time, has been purchased by Fred Zollner, who, it is claimed, will establish lighting connection with both this place and Courtney.

STREET RAILWAYS.

Blairsville, Pa.—Work on the proposed trolley road between here and Latrobe will commence soon. At the recent organization of the company officers were elected as follows: President, Thomas Brown; vice-president. G. W. McHenry; treasurer, William Doherty.

Boulder, Col.—J. E. Sidwell has made application for a franchise for a new electric line here.

Carrollton, O.—D. B. Lee, of Harlem Springs, is at the head of a company that is trying to secure the right of way for a trolley line between Amsterdam and this city.

Des Moines, Ia.—F. S. Mordant, of F. S. Mordant & Co., of Chicago, is interested in a new electric line to be built from here via Albany and St. Joseph to Kansas City.

Lebanon, Pa.—Joseph F. Raymond is interested in a new company being formed here to build an electric railway.

New York City.—The contract for the building and installation of the first electro-magnetic railroad to come into existence in this or any other country has been awarded to R. S. Bishop & Co., of 11 Broadway. The road, which is of the elevated type, is to run from South Beach, S. I., to a point near Midland Beach, and will be about 2 miles in length. Under the terms of the contract, the road is to be finished and in working order five weeks hence.—The Interborough Rapid Transit Company is contemplating the extension of the Third Avenue elevated line to Yonkers by continuing the elevated structure to Pelham avenue northward in an almost straight line to Woodlawn and crossing over above Woodlawn Cemetery and Van Cortlandt Park to Yonkers Township.

Oxford, Pa.—The Oxford, Cochranville & Parkesburg Electric Railway Company has been chartered to build a line, 14 miles long, from here to Parkesburg. Its capital stock is $84,000.

Philadelphia, Pa.—The Union Railroad Company, of this city, has the contract to build the trolley line from Yardley to New Hope.

Rochester, Minn.—Several St. Paul men, including President Stickney, of the Great Western, are at the back of a project to build an electric line from St. Paul to this city.

Rochester, N. Y.—The Buffalo & Williamsville Electric Railway Company, which intends to extend its lines to this city, has been granted authority by the Railroad Commission to mortgage its property for $3,500,000 on condition that but $500,000 in bonds shall be issued without further permission from the commission, and to increase its capital stock from $75,000 to $3,500,000, only $500,000 of the new stock to be issued at this time.

Spokane, Wash.—The Spokane Traction Company has been granted a franchise to build a double-track electric railway system here.

Steubenville, O.—The project of building a traction line between here and Canton is being renewed. Messrs. Fingle & Eckley, of Carrollton, are looking after the project in that town.

Zanesville, O.—Dr. Hissey is at the head of a company which proposes to build a traction line to Crooksville.

POWER PLANTS.

Ann Arbor, Mich.—The Michigan Milling Company will erect a power plant here.

Canaan, Conn.—Lawyer J. Henry Roarabeck, of this city, representing New Haven capitalists, has been securing options on water power sites on the Konapot River in Mill River, which is located a short distance across the State line in Massachusetts. The purpose is to erect a large power plant and to transmit electricity for lighting purposes to this place, Norfolk and other towns in this State.

Carlisle, Pa.—The York Haven power plant, which was lately destroyed by fire, is to be rebuilt.

Chattanooga, Tenn.—At a recent meeting the city council voted in favor of a bond issue of $1,000,000, the money to be used in building an electric power plant at the suck, 13 miles below this city in the Tennessee River.

Redding, Cal.—Another company has been formed to create electrical power in Shasta County. It is known as the Mount Lassen Water & Power Company. The company proposes to install a 10,000 hp. plant on Battle Creek, 35 miles southwest of here, and to furnish power and light to this city, Red Bluff, Corning and Chico.

BIDS WANTED.

Washington, D. C.—Sealed proposals will be received at the office of James Knox Taylor, supervising architect, until 3 o'clock P.M., June 30, for the construction (including plumbing, heating apparatus, electric wiring and conduits) of the United States Postoffice at Gainesville, Tex., in accordance with drawings and specifications, copies of which may be had at the supervising architect's office, or at the office of the postmaster at Gainesville.

Wyoming, Pa.—Sealed proposals to furnish the boroughs of Wyoming and West Wyoming with electric light with be received until noon June 20, 1904, for both open and inclosed arc lamps as follows: 25 or more standard 2,000 cp. lamps for the Borough of Wyoming, 20 standard 2,000 cp. lamps for the Borough of West Wyoming, to be placed at such points along the streets in each borough as the respective borough councils may designate; and shall maintain the same for a period of five or eight years. For further information or form of contract, J. B. Schooley, Wyoming, Pa., or Harry Schooley, West Wyoming, Pa., may be addressed.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12⅝c.; Lake 12⅝@12¾c.; casting, 12⅛@12¼c.

The United Traction & Electric Company of New Jersey has declared a dividend of 1¼ per cent., payable July 1.

Stockholders of the Montreal Street Railway Company have ratified an increase in capital stock of $1,000,000, making the total stock $7,000,000.

It is reported that the gross earnings of the Philadelphia Rapid Transit Company for the year will exceed $16,000,000, against $15,436,573 last year.

The Western Union Telegraph Company has declared the regular quarterly dividend of 1¼ per cent., payable July 15. Books close June 20 and reopen July 1.

It seems probable that the exports of copper for the full month of June will aggregate between 15,000 and 16,000 tons, being several thousand tons less than the March outgo.

At the annual stockholders' meeting of the Chicago Edison Company Monday the retiring directors were re-elected and no action was taken on the expected issue of new stock.

The Strowger Automatic Telephone Exchange, Chicago, has declared the regular semi-annual dividend of 50 cents a share, payable July 1. Books close June 20 and reopen July 5.

The St. Joseph (Mo.) Railway, Light, Heat & Power Company has declared the regular quarterly dividend of 1¼ per cent. on its preferred stock, payable July 1 to holders of record June 18.

It is stated that the Interborough Company of New York will have earned 5 per cent. upon its $35,000,000 of stock for the year to end June 30 from the surplus earnings of the Manhattan Elevated, interest, etc.

The Kinloch Long Distance Telephone Company of St. Louis has filed a $5,000,000 mortgage upon all its property in favor of the American Trust and Savings Bank of Chicago, trustees, for the holders of the 25-year 5 per cent. gold bonds.

It is reported from Boston that the directors of the Western Telephone & Telegraph Company at their meeting next month will declare a semi-annual dividend of 3 per cent. on the preferred stock, placing the stock on a 6 per cent. basis.

It is claimed that for the first five months of the General Electric Company's fiscal year the gross business and net profits of the company have been practically equal to last year, the changes in net profits not varying $10,000 per month.

The Manhattan Elevated of New York and the Brooklyn Rapid Transit Company are now both showing about the same gross earnings, $15,000,000 per annum, only the Manhattan secures its earnings from 37 miles of road, while the B. R. T. system consists of 248 miles.

The Warren, Cortland & Jefferson Traction Company of Ohio has filed a mortgage to the Eastern Trust Company of New York to secure $1,250,000 five per cent., 25-year gold bonds for construction not to exceed $30,000 per mile of single track, or $35,000 per mile of double track.

The Rochester (N. Y.) Gas Company, the Rochester Light & Power Company, and the Rochester Street Railway Company are being consolidated. Minority interests have brought suits to prevent, by injunction, the consolidation on the ground that more than $5,000,000 of water is to go into the bonds and stocks of the consolidated company.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price June 13
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	144¾
Metropolitan Street Railway	113¼
Metropolitan Securities	80½
Ninth Avenue	195
Third Avenue	121
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	47⅝
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	65¼
Philadelphia Traction	95¾
Union Traction, $17.50 paid	49⅞
Boston.	
Boston Elevated, full paid	141
West End Street, com	90
do. do. do. pref	111
Chicago.	
City Railway	175
North Chicago	71
Union Traction, com	5¼
do. do. pref	29½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	32
do. do. pref	66
Electric Lead Reduction	⅝
Electric Vehicle, com	9
do. do. pref	12
Westinghouse, com	156
do. pref	194
General Electric	157
Boston.	
Edison Electric Illuminating	235
General Electric	157½
Massachusetts Electric Companies, com	19
do. do. do. pref	70
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	142
National Carbon, com	28
do. do. pref	102
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	55
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	128½
Western Telephone Company	7¼
New England Telephone Company	120⅝
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	87½
Miscellaneous.	
Chicago Telephone Company	116
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

Weston Patent Upheld.

Another decision has been rendered in the United States District Court in favor of a Weston patent.

The decision was rendered by Judge Holt on June 13, in an action brought by the Weston Electrical Instrument Company against the Empire Electrical Instrument Company and the F. A. La Roche Company to restrain the alleged infringement of a patent issued on May 16, 1893, to Edward Weston, and transferred by him to the Weston Electrical Instrument Company, for shunts for electric light and power stations.

Judge Holt sustained the Weston invention and granted the complainants a decree of perpetual injunction against the defendants' machines. In rendering his decision the Court said:

"La Roche is a man not only without any scientific education, but without even the ordinary electrical knowledge of a skillful electrical mechanic; that his reputation for veracity is bad; that his shunt never was used as a measuring instrument in connection with his voltmeter between 1884 and 1889; that the various pieces of apparatus constituting the voltmeter were put together by La Roche after the issue of the patent and sent to Weston, with the object of being used in support of his own untruthful testimony to be given in this and other suits for the purpose of attempting to invalidate this and other patents to Weston; that a part of the apparatus contained in the voltmeter is two magnets, which are so arranged that their poles neutralize each other; that, as a result, it is impossible for a current of electricity to pass through the instrument; that, therefore, the instrument is and always has been entirely inoperative, and the shunt could not have been used in connection with it. In short, I cannot avoid the conclusion that the testimony of La Roche in this case was deliberately and intentionally untruthful, and that to support it he deliberately fabricated an instrument to be used upon this and other trials involving Weston patents."

* * *

Weather Reports.

On Friday last the Weather Bureau was ordered to add wireless telegraphy to the present equipment, so that with ordinary transmitters vessels can report when not over 200 miles off shore. This extension will be made on both the Atlantic and Pacific coasts.

The popular interest felt in the Weather Bureau, and the increasing attention given to the subject of meteorology, has prompted the Department of Agriculture to have prepared a monograph about this important branch of the Government service. The very important part electricity plays in the work of the Weather Bureau makes the monograph of interest to the electrical fraternity and its essential features are herewith presented.

The invention of the thermometer and barometer by Galileo about the year 1600 marked the beginning of accurate meteorology and of the scientific investigation of the atmosphere. But it was not until 1848, when the successful operation of Morse's electro-magnetic telegraph was fully demonstrated and meteorology had further developed, that the feasibility of a storm-warning system, based upon telegraphic reports of meteorological observations, was announced both in Europe and in America.

The American system of simultaneous meteorological reports by telegraph, on which are based the daily forecasts and storm warnings of the Weather Bureau, was developed in 1870 under the authority of an act of Congress. On November 1

1870, twenty-four stations began the regular transmission of meteorological observations by telegraph to the Washington office, and a few days later the new service, then a branch of the army, under the direction of Gen. Albert J. Myer, telegraphed its first storm warning.

The number of regular meteorological stations of the Weather Bureau at the present time is about 180, and each is in charge of a trained observer. Telegraphic reports are received from these stations situated in various parts of the United States and on the islands of the adjacent seas, and, by a system of exchange, from three Mexican stations and twenty stations of the Dominion of Canada. Daily reports by cable are received from the Azores and from several localities in Western Europe.

In telegraphing his report to the office at Washington the local observer uses a cipher code. The average number of cipher words in observation messages is probably about five for each station. The messages are transmitted over telegraphic circuits, and are received simultaneously at all places on the same circuit. A similar course is pursued when the messages are transferred from one circuit to another, so that each telegraphic office sends the report from its own station but once. The reports are "all in" about 10:30 A.M. As soon as each sheet of the cipher messages is received at a Weather Bureau office the observers rapidly enter the data on geographical charts of the United States.

Thus it will be seen that in the gathering and disseminating of the weather reports electricity is very largely used. In fact many of the instruments would be utterly worthless without the aid of the electric current.

* * *

Electrical Apparatus in the Philippines.

The value of the gross shipments into and from the Philippine Islands during the year 1903 is reported to have approximated $66,000,000, the exports being slightly less than the imports. The Philippine Commission, in its last annual report, outlines the status of the industrial and commercial conditions at the close of the year, and though not presenting a very hopeful view of the immediate future, each move looking to the commercial advancement of the islands is shown to have been made only as the result of the most careful investigation.

The value of the importation of cars for electric railways during the past year only reached a total of $3,791, as against $8,927 in 1902, the United Kingdom and Germany being the main sources of supply.

The value of the importations of incandescent electric lamps was $6,925 as against $8,182 in 1902. The largest import value was to the credit of the United States, $4,634; Germany standing second with that of $1,753; the other contributions being in several small amounts.

One item coming up with a satisfactory showing for the past year is that of electrical machinery, the value of which was $15,560 as against $3,530 in 1902. Of the contributions during the past year the United States contributed $11,484, England, $2,104; Germany, $281; France, $1,034; China, $250; Japan, $252, and Australia, $155.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A New York banker while on a Western trip made the startling discovery "that steam railroad earnings in the central West are being seriously affected by electric railway competition."

The representatives of the Allis-Chalmers Company have made the appraisement of the Bullock Electric Manufacturing plant of Cincinnati at $2,716,000.

Dr. J. Mount Bleyer of New York has announced that he has discovered a special class of glass peculiarly adaptable for Roentgen rays. He says that he found while experimenting that this glass fluoresced bluish, and on making a number of crucial tests he discovered that a tube gave out bi-ultra-violet rays in combination with Roentgen rays, much richer than he had ever observed before from any tube made from other kinds of glass.

At its 22d annual meeting, held last Wednesday, the New York Electrical Society elected the following officers: President, Frank J. Sprague; vice-presidents, C. G. Young, E. H. Mullen, F. C. Bates, Albert F. Ganz, Louis B. Marks and W. S. Rugg; secretary, George H. Guy, treasurer, Henry A. Sinclair.

It is asserted in electrical circles that while the Curtis turbine of the General Electric Company is a mechanical as well as commercial success, it has not been perfected to the complete satisfaction of the General Electric people. The company has a large force of experts working upon the matter which will probably result in improvements to the wheel to increase the efficiency.

Municipal ownership of electric, gas and water plants have not proven very profitable or satisfactory in Canada, according to a report just received by the State Department from U. S. Consul-General Holloway at Halifax. Profits are shown in 44 cases and losses in 48.

Special Master Everett W. Burdett of Boston has resumed hearings in the American Bell Telephone-Western Union Telegraph Company royalty suit. Five hearings have thus far been held.

The New York Central Railroad management has issued orders to its ticket agents, principally in central and western New York, to reduce local passenger fares at such points along the line of the road as come into competition with trolley lines. In many instances the fares charged by the Central will be the same as those charged by the trolley companies, and in a few cases they will be less. The company intends to run additional trains along sections where there is trolley competition.

The Department of Physics of Columbia University, New York City, will try to make the radium exhibit in the Columbia pavilion one of the great attractions of the St. Louis Fair, and so present it to view as to make it as easy for the layman to understand as for the scientific expert. There will be shown samples of pitchblende, uraninite, willemite, polonium, thorium, uranium and radium, all of which substances are radio-active. In addition to these the exhibit will contain a modification of the Crookes radio-meter, which is driven by the heat evolved from the radium, and also a small acting electroscope devised by Mr. Strutt and later improved in the Columbia research laboratories.

A bakery, the heat for which is generated electrically, has recently been put in operation in Montauban, France. According to *Cosmos*, the conversion has been carried out without any essential alterations in the construction of the oven and heating by wood may be reverted to whenever required.

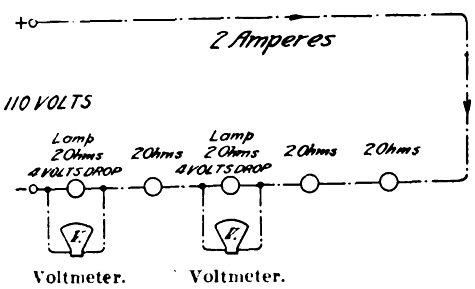
The largest order for copper wire that has ever been given in Canada has recently been received by the Dominion Wire Manufacturing Company. The wire is for the Toronto-Niagara Power Company, and consists of 500 miles of stranded cable, about half-inch, weighing about 1,500,000 pounds, and having a value of about a quarter of a million dollars. It will furnish six transmission lines, connecting Toronto and Niagara Falls.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 327.*)

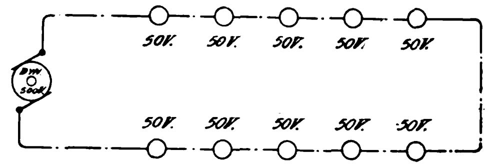
Calculating Drop in Volts.—In a single circuit the calculation of the drop of pressure is made by using Ohm's Law in the form previously given: $E = C \times R$, or volts drop = amperes × ohms. For instance, what is the loss of volts in a simple circuit whose resistance is 10 ohms carrying a current of 2 amperes? According to the rule drop in volts = 10 ohms × 2 amperes or 20 volts. If the circuit is supplying current to lamps, then the volts are 110 where the current enters; where it leaves in the above case, it would be 20 volts less, or only 90 volts; 20 volts disappearing through the effect of the resistance and current.



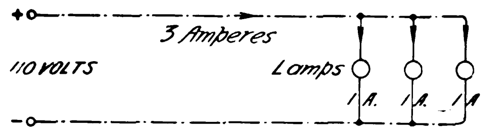
LAMPS IN SERIES, 4 VOLTS DROP PER LAMP.

In the above sketch the lamps are shown in series with each other; that is, the same current passing through one lamp after the other. As two amperes pass through each lamp as indicated, and as each lamp has two ohms resistance, the drop between the ends of each lamp would be $2 \times 2 = 4$ volts. Voltmeters are shown in position across the terminals, each giving a reading of four volts, which is a reading of the drop taking place in the lamp. An experiment of this kind can be tried with five 110 volt lamps arranged as shown. Only one voltmeter is necessary for readings from every lamp. When they have all been obtained their sum will equal the total voltage applied.

Series Electric Lighting.—A very practical example of the above case of series lighting can be found in high tension arc lighting, so universally employed in large cities. The lamps are placed on street corners as a rule, and extend through the city in this manner for a distance of several miles. A current of about 10 amperes is employed, and each lamp has the equivalent of a resistance of 5 ohms. According to these figures each lamp will have a drop of 50 volts; therefore, if 10 lamps are lit, 500 volts are required, for 20 lamps 1,000 volts, 40 lamps, 2,000 volts, etc. In a lighting system of this kind all wiring is done in series, in contradistinction to incandescent light wiring, which is done in multiple. The difference between the series system and the multiple system of wiring is readily illustrated by a simple sketch.



HIGH TENSION ARC LIGHT SYSTEM, SERIES WINDING



INCANDESCENT LIGHT SYSTEM, MULTIPLE WIRING.

Multiple Wiring.—In a multiple circuit the current divides up; each part of the circuit taking current according to its resistance, as shown by Ohm's Law. In the cases mentioned three amperes divide up into three separate currents of one ampere apiece. The current divides as shown because the resistance of each branch will not permit any more to pass through.

Example: The lamps each take 1 ampere at 110 volts, what is the resistance of each lamp? Referring to the table previously given, it will be seen that this is a case where volts and amperes are given to find ohms. According to the rule, volts divided by amperes gives ohms; therefore 110 divided by 1 gives 110 ohms per lamp.

What is Meant by Percentage of Drop.—The drop in either a series circuit or a multiple circuit is calculated from the amperes and ohms of the circuit. A very simple formula is employed for the purpose of obtaining the size of wire in circular mils, in which a stated loss of volts occurs. For instance, if a building is wired for incandescent light, it is customary to make an allowance beforehand for the drop in volts. This allowance may be 2 per cent., 3 per cent., etc., as the circumstances warrant. If 110 volts are supplied to the lamps, 2 per cent. or 2.2 volts will be purposely wasted in the circuits before it reaches the lamps. The lamps will therefore receive only 107.8 volts. In using the formula the number of volts to be dissipated in the circuit under consideration must be given.

Formula: Circular mils = feet of wire × amperes in wire × 11 ÷ volts drop in wire.

Example: Take a circuit 250 feet long carrying 10 amperes, in which 3 volts drop will be allowed, how many circular mils cross section must be supplied for the wire? According to the above, a circuit with a 250 foot run must have 500 feet of wire, giving circular mils equal to $500 \times 10 \times 11 \div 3 = 18{,}333$. The formula is given in symbols in the following form: $\text{C. M.} = \dfrac{11 \times F \times A}{V}$, where F = feet of wire, A = amperes, 11 is a constant, V = volts drop and C. M. = circular mils. The constant 11 is the resistance in ohms of 1 mil foot of copper wire.

Table showing effect of percentage of drop on circular mils of wire required.

$$\text{Formula:}\quad \frac{11 \times F \times A}{V} = \text{C.M.}$$

Amperes.	Percentage of drop.	Circular mils.	Feet of wire.	Volts drop.
10	1	100,000	1,000	1.1
"	2	50,000	"	2.2
"	3	33,333	"	3.3
"	4	25,000	"	4.5
"	5	20,000	"	5.5

Volts for lighting = 110.

The volts supplied are supposed to be fairly constant; the amperes may vary according to the number of lamps burning. The amount of copper is well represented by the circular mils in each case where the percentage of drop is varied. With 5 per cent. drop only one-fifth of the copper required in the first case is necessary.

Sizes of Wire and Circular Mils.—The sizes of wire are known by reference to the number of circular mils they represent and vice versa. The number of circular mills of a round wire may be obtained by squaring the diameter of the wire in mils.

For instance, a wire one-tenth of an inch in diameter is $\frac{100}{1000}$, or 100 mils in diameter; the square of 100 mils is $100 \times 100 = 10{,}000$ circular mils.

Resistance and Circular Mils.—For practical purposes it is safe to assume 11 ohms resistance for a wire 1 foot in length and one circular mil in cross section. Therefore the resistance of a wire 1 foot long and having two circular mills cross section will be one-half of 11 ohms or 5.5 ohms. On this basis fewer circular mils to a wire mean more resistance and more circular mils means less resistance. The resistance of wires can be calculated by a simple formula which expresses the idea just stated in a concise form.

Formula: Resistance in ohms equals feet of wire × 11 ÷ circular mils.

Example: For instance, what is the

resistance of 100 feet of wire of 1,000 circular mils? The answer is, ohms equals 100 × 11 ÷ 1,000 = 1.1 ohms.

From the foregoing it is not a difficult task to arrange a table showing the relationship existing between the length of a wire, its cross section in circular mils and its resistance in ohms.

Table based upon the formula, showing the relation between ohms, feet of wire and circular mils.

Formula: $R = \dfrac{11 \times \text{ft. wire}}{\text{Circular mils.}}$

Circular mils.	Ohms.	Feet wire.
1,000	11.0	1,000
2,000	5.5	"
3,000	3.666	"
4,000	2.75	"
5,000	2.2	"
10,000	1.1	"

With the number of feet of wire constant, the resistance is inversely proportional to the circular mils. For instance, with C. M. = 1,000, R. = 11 ohms, but with C. M. = 10,000, R = 1.1 ohms, showing that with 10 times the cross section the resistance becomes one-tenth.

Resistance in Multiple.—Calculating the joint resistance of a number of resistances in multiple can be accomplished at once if the resistances in multiple are equal in the first case, or by a simple calculation if the resistances in multiple are unequal in the second case.

Resistances are Equal.—When resistances are in multiple and are equal to each other take the resistance of one and divide it by the number of resistances.

Example: For instance, take a circuit consisting of 20 lamps in multiple each having a resistance of 100 ohms, what is the total resistance? The total resistance is equal to the resistance of one lamp, which is 100 ohms, divided by the number of lamps, which is 100 ÷ 20 = 5 ohms.

Equal resistances in multiple.

Formula: $R = \dfrac{\text{resistance of 1 branch}}{\text{number of branches.}}$

Number of resistances.	Resistance of each.	Total resistance.
50	1,000 ohms	20 ohms.
40	800 "	20 "
30	600 "	20 "
20	400 "	20 "
10	200 "	20 "
5	100 "	20 "

In dealing with incandescent lamps a fact to be remembered is that the resistance of the lamp cold is much greater than its resistance hot. A 16 cp., 110 volt lamp cold, has a resistance of 450 ohms; when it is burning its resistance drops to about 120 ohms. Therefore if a bank of lamps are measured cold, when in multiple, the resistance will be much higher than when their total resistance is calculated from the volts and amperes they require when lighted.

Resistances are Unequal.—When resistances in multiple are unequal a simple calculation is employed. The rule is as follows: The total resistance is equal to the reciprocal of the sum of the reciprocals of the resistances. The practical application of the rule can be best shown by a case in point. Example: What is the resistance of the following resistances in multiple: 5, 10, 15 and 20 ohms? According to the rule

$$R = 1 \div (\tfrac{1}{5} + \tfrac{1}{10} + \tfrac{1}{15} + \tfrac{1}{20}).$$

In other words, add the fractions together whose numerators are now one, and whose denominators are the various resistances in multiple. In the above case $R = 1 \div \frac{25}{60} = \frac{60}{25} = 2.4$ ohms. It will be noted that the resistance of a group of unequal resistances in multiple is always less than the lowest resistance of the group. For instance, in the case just given the total resistance 2.4 ohms is less than the lowest resistance of the group, which is 5 ohms. Adding up the reciprocals of the resistances and inverting the fraction explains the above process. To illustrate, take the resistances 1, 2, 3, 4 and 5 ohms in multiple, what is their total resistance? If the reciprocals are added together the fraction obtained is $\frac{137}{60}$. Inverting this fraction gives the answer $\frac{60}{137} = .438$ ohms. If the various resistances in multiple are fractional they must be treated in the same manner, although the reciprocal of fractions such as $\frac{1}{2}$ is 2, $\frac{1}{4}$ is 4, etc.

which while performing the function of generating electromotive force, are at the same time acting in the capacity of conductors which possess resistance and develop drop in the operating machine. The part referred to is the armature, and allowance must be made for this deficiency when the dynamo is running at one-quarter, one-half, or full load. Take the case of a 100-light generator; its amperes at 110 volts pressure are approximately 50, if the armature resistance is one-tenth of an ohm, the drop at the indicated points of load will be respectively:

Drop at one quarter load = 12.5 amperes × .1 ohm = 1.25 volts.

Drop at one-half load = 25.0 amperes × .1 ohm = 2.50 volts.

Drop at full load = 50.0 amperes × .1 = 5.00 volts.

It is but natural to suppose that this will have its effect upon the candle power of the lamps. At full load a 110 volt lamp will receive only 105 volts, which will mean a great depreciation in illuminating power, sufficient perhaps to make electric lighting on this basis an expensive luxury.

A modern dynamo is built to automatically build up its electromotive force as the load increases. Such dynamos are called compound wound dynamos, and are of immense service in comparison with the older type, in which regulation was only obtained by hand.

In an electric light system the following items must be considered:

Drop in the armature.
" " switchboard.
" " in the mains.
" " feeders.
" " branches.

The drop in the armature need not be considered as part of the drop in a wiring

Unequal Resistances in Multiple.

Formula: $R = 1 \div \left(\dfrac{1}{\text{R of 1st branch}} + \dfrac{1}{\text{R of 2d branch}} + \text{etc.}\right)$

Resistance in multiple. Ohms.	Sum of reciprocals of resistances.		Total resistance. Ohms.
1, 2, 3	$1 + \frac{1}{2} + \frac{1}{3}$	$\frac{11}{6}$	.545
1, 2, 3, 4	$1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4}$	$\frac{25}{12}$	.480
1, 2, 3, 4, 5	$1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}$	$\frac{137}{60}$	.438
10, 20, 30, 40, 50, 60	$\frac{1}{10} + \frac{1}{20} + \frac{1}{30} + \frac{1}{40} + \frac{1}{50} + \frac{1}{60}$	$\frac{147}{600}$	4.081
$\frac{1}{2}, \frac{1}{4}, \frac{1}{3}, \frac{1}{8}$	2 + 4 + 3 + 8	17	.0588
$\frac{1}{10}, \frac{1}{20}, \frac{1}{30}, \frac{1}{40}, \frac{1}{50}$	10 + 20 + 30 + 40 + 50...	150	.00666

Examples of Drop of Potential.—The drop of pressure in a circuit is not the only instance of a waste of energy met with in actual practice. The dynamo is also affected in its most vital part by the passage of a current through conductors, system, although indirectly it contributes to the difficulty of solving special problems. Loose joints and poor connections were a source of great danger and loss of power in wiring of the past decade, but the severe inspection of to-

day has obliterated such evils. It is within the province of a treatise on wiring to embrace all questions relating to the passage of the current after leaving the dynamo. As the ultimate object of wiring is to limit the waste of power and the amount of copper employed, as well as to secure good candle power for the lamps, data on all three is of the utmost importance in the consideration of wiring for power and distribution of power.

Calculation of Power.—Power is calculated in watts. Watts are equal to the product of volts by amperes. If either the volts or amperes of a circuit are increased or diminished, the power will be correspondingly increased or diminished. For instance, what is the power obtained from 110 volts and 25 amperes? The answer is 25 × 110 = 2,750 watts. The watts can be still further transformed in horse-power by dividing them by 746. There are 746 watts in a horse-power, therefore 2,750 watts ÷ 746 = 3.68 horse-power, generally denoted by the symbols hp.

Power Table, showing relationship between watts, volts and amperes.

Volts.	Amperes.	Watts.	Horse-power.	Kilowatts.
1,000	100	100,000	134.0	100
500	200	"	"	"
250	400	"	"	"
125	800	"	"	"

Kilowatt.—The kilowatt simply means 1,000 watts, and roughly represents 1⅓ hp. Manufacturers rate their dynamos on this basis instead of speaking of their horse power or lighting capacity in lamps. The power consumed by an incandescent lamp varies from 3 to 4 watts per candle power. A 16 cp. lamp takes from 48 to 64 watts. A horse-power would supply power for from 11 to 15 lamps, depending upon their rating per candle power.

COMPOUNDING THREE-WIRE MACHINES.

In a recent issue of the *Zeitschrift fur Elektrotechnik* there appeared a short article from the pen of E. Rosenberg dealing with the above question. When machines designed to supply current to a three-wire network are provided with compound winding, it is generally necessary for the current carried to both outer conductors to pass through the main winding. The machine shown diagrammatically in Fig. 1 has an auxiliary brush, b, mounted on the commutator, C, between the main brushes, B_1 and B_2. It is usual, as here shown, to split the main winding into two parts, each connected to an outer conductor. If the current in the first outer conductor be J_1 and in the second J_2, the number of turns in each coil being $\frac{N}{2}$, then the magnetization in ampere turns produced by the main winding is

$$\frac{N}{2} . J_1 + \frac{N}{2} . J_2.$$

The division of the main winding is, however, not always convenient. For instance, if it were desired to parallel an ordinary compound machine with one arranged to supply to a three-wire network, it would be necessary, in order to connect the balancing wires, to couple the series windings of both machines in circuit with the same outer conductors.

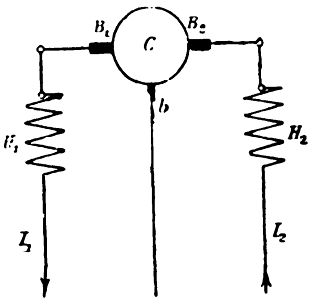


FIG. 1.

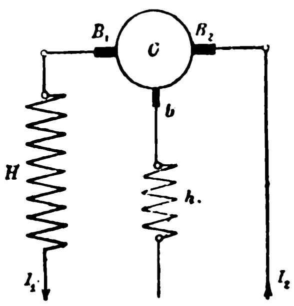


FIG. 2.

Moreover, the divisions of the windings frequently presents difficulties, especially when it is a case of adapting a machine for the three-wire system. If, for instance, all series coils be connected in parallel, as is usual for heavy currents, the division can only be effected with a considerable reduction of efficiency. And since, after the division, only half the number of coils is connected in parallel,

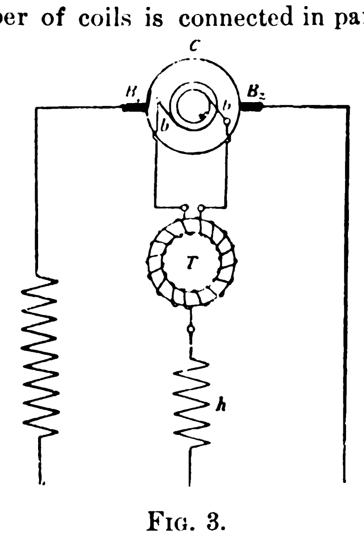


FIG. 3.

it follows that in order to prevent twice the former volume of current from passing, a resistance must be connected in parallel designed to carry an equal share of the current. In this case the loss due to the main winding will amount to double the normal, while by dispensing with the resistance or over-compound winding the fourfold loss would be incurred. The author proceeds to describe how the main winding may be connected unaltered in circuit with one of the outer conductors, the balancing being effected by a second main winding being in circuit with the middle wire. Fig. 2 shows the arrangement when the division of the voltage is effected by means of an auxiliary brush resting on the commutator, while Fig. 3 represents that patented by the Allgemeine Elektricitats-Gesellschaft, in which case this division is made by an external choking coil whose ends are connected through slip-rings, with two diagrammatically opposite points of the armature winding, while its center is connected to the neutral conductor. To obtain the same effect as previously, this winding is provided with half the number of turns contained in the main winding and connected in a similar manner. Its section is determined by the estimated amount of current required to balance. Assuming the current, J_1, which flows through the main winding, exceeds the current, J_2, in the second outer conductor, then an out-of-balance current, $J_1 - J_2$, will flow through the middle wire, its direction being opposed to that of J_1. Further, if the main winding has N and the auxiliary winding $\frac{N}{2}$ turns, the resultant ampere-turns will be

$$N . J_1 - \frac{N}{2}(J_1 - J_2) = \frac{N}{2} . J_1 + \frac{N}{2} . J_2.$$

Hence a precisely similar effect is obtained as by halving the main winding. The efficiency is not reduced by the auxiliary winding so long as the machine has a balanced load. Even with the outer conductor unequally loaded, the loss of potential caused by the auxiliary winding may be reduced to a very small amount by correctly proportioning this winding.
—*Electrical Engineer, London.*

Growth of Electric Traction.

The electric railroads last year carried three times the population of the world. The cars ran three times the distance be-

tween the earth and the sun. The capital invested is twice as much as the United States bonded debt, and the gross earnings are $250,000,000. Taxes are paid amounting to $13,000,000.—*Philadelphia Press.*

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

TO CHANGE THE DIAMETER OF A DYNAMO PULLEY BY A SMALL AMOUNT WHEN NECESSARY TO OBTAIN EXACT SYNCHRONOUS SPEEDS OF ALTERNATORS FOR OPERATION IN PARALLEL.

Where it is difficult to obtain pulleys of exact relative sizes for synchronous operation of generators, the diameter can quite easily be increased ½ inch by means of a paper covering. To do this, the pulley—no matter of what material it is made—should be thoroughly cleaned of all grease and oil, and the surface roughed up by scraping or draw filing. Heavy manila paper cut to the right width is glued to this surface, care being taken to have the glue hot and not too thick. Press the paper firmly down upon the pulley face in starting, and then draw the paper tight as the pulley is turned, pressing and pounding the surface carefully as each additional section is glued.

When one complete cover is fastened to the face of the pulley, the glue is applied to the exposed surface of the paper, and the operation continued, being careful to see that no bubbles or wrinkles are left on the surface.

If it is desired to make a crown on the pulley, this can be done by gradually narrowing down the width of the sheets that are being glued.

This glued-paper addition to the pulley forms a substantial, lasting surface, and makes a very good surface for the belt to drive upon.

W. E. EMERY, Madison, Wis.

AN ELECTRIC SIREN USED IN PLACE OF A TELEPHONE GONG.

I take pleasure in inclosing herewith a wrinkle that we have had in use in our station for several years; it has been quite a curiosity to people from other places who have visited us from time to time. You, no doubt, have experienced trouble in having telephone calls answered promptly by the operators in your central station. To overcome this trouble we made and put in several years ago what we call an electric siren. This piece of apparatus is nothing more or less than a horn, operated on an alternating current of electricity. We have made out the working drawings so that should any one be disposed to manufacture one it can be very easily done at an expense of five or six dollars, and the result will be that from the time it is installed there will be no further excuse for not hearing the telephone ring, as a machine of this kind

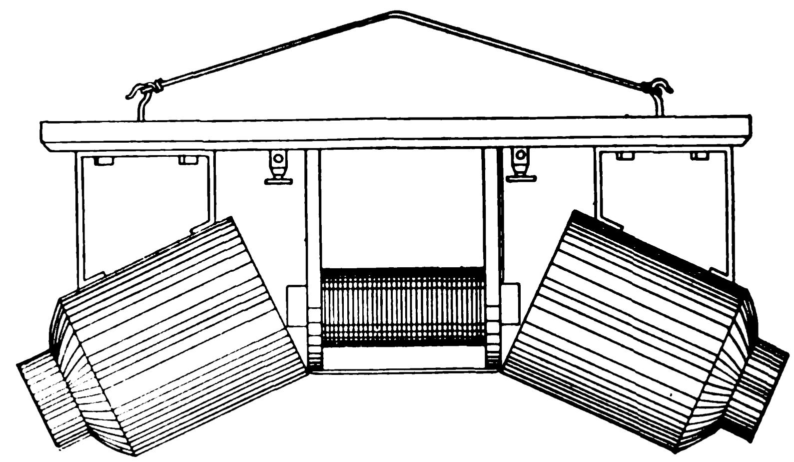


FIG. 1.

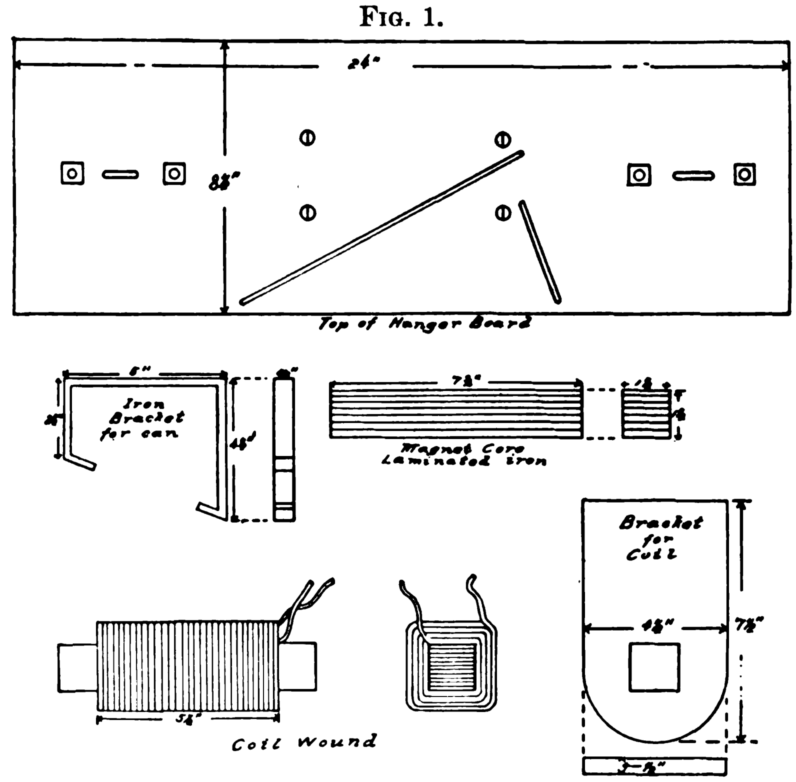


FIG. 2.

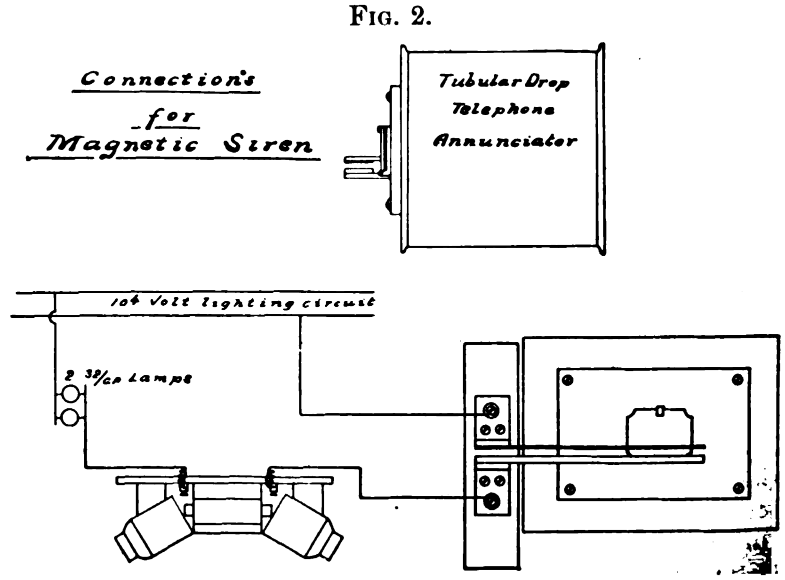


FIG. 3.
DETAILS OF MAGNETIC SIREN.

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

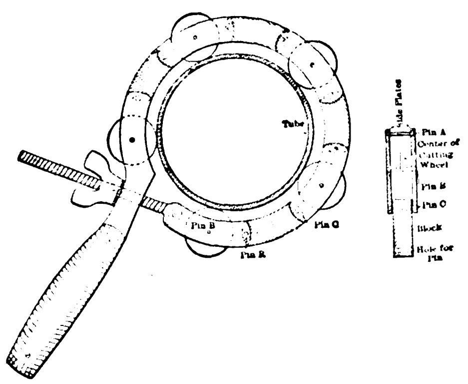
can be heard several blocks from the station.

F. G. Proutt, Memphis, Tenn.

A TOOL FOR CUTTING OUT A BOILER TUBE FROM A WATER-TUBE BOILER.

Perhaps the accompanying diagram will give you a suggestion that some of the members of the association have not had in regard to cutting out a tube from a water tube boiler.

The principle is that of a bicycle chain made of alternate steel blocks and plates, the cutter wheels being set between the plates. With five cutters the tube can be cut out by moving the handle one-fifth of



Tool for Cutting Out Boiler Tube.

the distance around the tube and then back again, etc. We have made these in our own shop for about $3, buying the wheels. We find that we can cut out ten times as many tubes from a water-tube boiler in a day as we can with the old method.

A. J. Goddard, Freeport, Ill.

AN ELECTRIC BELL USED AS AN ALARM TO TELL WHERE A CIRCUIT-BREAKER IS OPEN.

We had trouble with our power circuit. The circuit-breaker would go out occasionally and the noise of the station usually prevented the attendants from hearing it, so the circuit would remain open until the ammeter was read or some consumer complained. To avoid this trouble we put a bell on the 110-volt circuit, with contacts arranged so that the bell circuit would close when the breaker was open. The noise of the bell could easily be heard by the attendants and the circuit breaker was closed.

Jas. Dahles, Lincoln, Neb.

KEEPING A COMMUTATOR IN GOOD SHAPE WITHOUT TURNING OR SANDPAPERING.

In taking care of a commutator on a D-62 generator, it was with much difficulty and turning that we kept it from sparking badly. We finely remedied the trouble entirely by taking a piece of soft sawed paving sandstone, about the width of the commutator, and holding it on while running. Even with current being generated the commutator was dressed up so that sparking ceased, and ran smoothly. The stone soon gets a concave shape to fit the surface of the commutator, and then does still better.

D. L. Davis, Salem, O.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE VI.

BY W. H. WAKEMAN.

As the required dimensions and strength of riveted joints were treated in detail in previous issues of this paper they will not be repeated here. Required qualities of boiler plate will receive due attention as forming part of the United States rules for determining the strength of steam boilers.

A rule for calculating the tensile strength of plate was given and illustrated in Article II, but the matter will be more fully presented here in order to complete the rules which come under this head.

For testing steel plates, a piece must be cut from each plate and given the form shown in Fig. 9. The wider parts shall be about 6 inches long and 2 inches wide, while the reduced section is 1 inch wide. The length of reduced section of all steel plates 1 inch or less in thickness shall be determined as follows: Multiply the width by the thickness and the product by 8. For a steel plate .5 inch thick, the reduced section would be $1 \times .5 \times 8 = 4$ inches long.

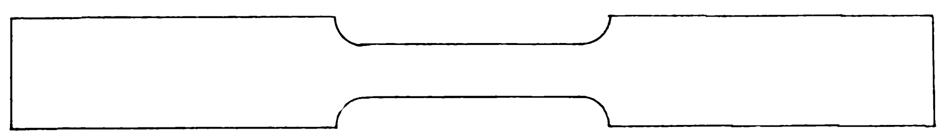


Fig. 9.

Suppose that this piece was put into a testing machine and a strain of 31,120 pounds was required to part it. The tensile strength per square inch is found by dividing the strain required to part a sample by the area of that sample. In this case it is $31{,}120 \div (1 \times .5) = 62{,}240$ pounds.

For iron plate the form of test piece is shown in Fig. 10. It must be 10 inches long and 2 inches wide, and the width of narrow part is determined as follows: For all plates $\frac{5}{16}$ inch or less in thickness it must be 1 inch wide. For plates $\frac{5}{16}$ inch or more in thickness the area of narrow part must be about .4 square inch. Variations of not more than .05 square inch will be allowed, but are not recommended. To determine the width of smaller part in accordance with this rule, divide .4 by the thickness. In this case it is $.4 \div .5 = .8$, therefore the width of reduced section must be .8 inch.

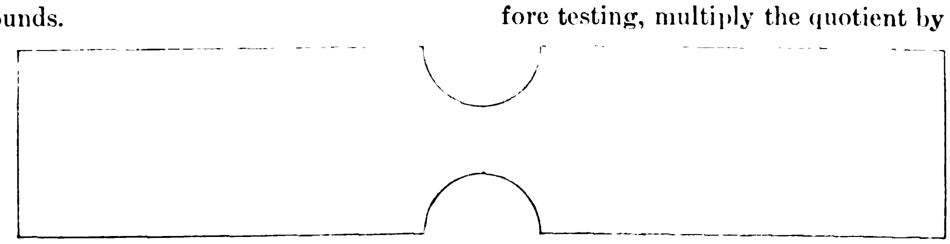


Fig. 10.

Suppose that a test piece of iron plate cut from material suitable for the boiler we have taken for illustration, which is .5 inch thick, required a pull of 20,542 pounds to part it. According to foregoing rules the tensile strength of that plate is $20{,}542 \div (.8 \times .5) = 51{,}355$ pounds per square inch.

Another object in producing these test pieces is to determine the ductility of the boiler plate. This refers to the quality of a piece of steel or iron which permits it to be rolled into wire without breaking. When a test piece of steel plate is put into a testing machine and force applied to it to draw it asunder, as it begins to lengthen, it grows smaller, or, in other words, its sectional area becomes less, and the amount by which it is reduced is a true indication of its ductility.

One clause of the United States laws for determining the strength of steam boilers, specifies that for steel plates $\frac{1}{2}$ inch thick or less, the ductility, or, in other words, the reduction of area shall be not less than 50 per cent. Plates that are more than $\frac{1}{2}$ inch and not over $\frac{3}{4}$ inch thick, must show at least 45 per cent., and those that are more than $\frac{3}{4}$ inch thick must not have less than 40 per cent. ductility.

Ductility of all plates is determined by the following rule: From the area of plate before testing subtract area after testing, divide the remainder by area before testing, multiply the quotient by 100 and the product is the per cent. of ductility.

For illustration take the test piece from steel plate shown in Fig. 9, which has a sectional area of $1 \times .5 = .5$ square inch

before the test, but after it is drawn asunder it is only .7 inch wide and .35 inch thick, giving a sectional area of .245 square inch. Applying the rule for calculating ductility results as follows: $.5 - .245 \div .5 \times 100 = .51$ per cent. As this is within prescribed limits, the plate is pronounced suitable for use in a steam boiler.

Had it been less than 50 per cent., the plate would have been condemned as unfit for use here, but that does not necessarily mean that it would be destroyed, or even used for tank purposes, as it is an easy matter to take it elsewhere and put it into a boiler, provided the inspection is less rigid and there is no law here on the subject. Such a transaction is a criminal act from a moral standpoint, but there is no legal way for punishing the parties responsible. A total lack of customers should be the result, teaching them that the way of the transgressor is hard.

The required ductility of iron boiler plate according to the United States rule for safe pressures is determined as follows:

For a tensile strength of 45,000 pounds it must not be less than 15 per cent., and for each additional 1,000 pounds it must show an increase of 1 per cent. This applies to a limit of 55,000 pounds tensile strength, making the required ductility for this strength 25 per cent. For all iron plates showing more than 55,000 pounds the ductility must be 25 per cent. in order to be accepted. As the iron plate under consideration comes under the 50,000 pounds head, the ductility must not be less than 20 per cent. The iron test piece illustrated in Fig. 10 is $.8 \times .5$ inch at the smaller part, making the sectional area .4 square inch before the test, but after rupture the size is reduced to .7 inch wide and .4 inch thick, giving a sectional area of .28 square inch. Applying the rule for determining ductility as before, results as follows: $.4 - .28 \div .4 \times 100 = 30$ per cent., showing that the plate is acceptable.

Another test prescribed by the United States rules for safe pressure of steam boilers, is to ascertain the percentage of elongation, or in other words the amount that a steel plate will stretch before it fails. It is calculated by the following rule, which refers to the narrow part of test piece in Fig. 9. From the length when the piece breaks, subtract the original length, divide the remainder by the length at time of failure and multiply the quotient by 100. Product is the per cent. of elongation

For illustration take the test piece shown in Fig. 9, the original length of which is 4 inches, and assume that at the time of failure it was 5.4 inches long. The result is an elongation of $5.4 - 4 \div 5.4 \times 100 = 26$ per cent., showing that the plate is acceptable.

The foregoing explanations and illustrations demonstrate that the rule laid down by the United States Board of Supervising Inspectors is very complete in all details when it is considered as a whole, as all points are well covered. This does not necessarily mean that we strictly agree with every part of it, neither does it prevent us from preferring another, provided good reasons for it are given, but when the rule is arbitrarily dismissed as unsatisfactory by anybody we are quite sure that a mistake is made.

There seems to be a misunderstanding among engineers concerning the abbreviated rule above referred to, as they think that a factor of safety of 6 is used, but this not correct. The rule states that the strain on boiler plate shall not exceed one-sixth of the tensile strength as determined by actual experiment, and for single riveted longitudinal seams this is not exceeded, but where these seams are double riveted an addition of 20 per cent. to the pressure is allowed, and this at once reduces the factor to 5. As the strength of joint is always less than for the solid plate, this reduces it further.

It will be remembered that the tensile strength of the steel plate that we used for illustration is 60,000 pounds, thickness of plate .5 inch, strength of riveted joint .75, and diameter of boiler 72 inches. The bursting pressure of it is

$$\frac{60{,}000 \times .5 \times .75}{72 \div 2} = 625 \text{ pounds.}$$

The safe working pressure as determined by formula No. 22, is 166.8 pounds. Under these conditions the actual factor of safety is $625 \div 166.8 = 3.75$, which is quite different from 6.

There are two reasons for using this low factor of safety, one of which is the fact that in constructing boilers for the navy it becomes necessary to allow high pressures in order to secure the greatest possible power from a given weight of boiler. The other reason is that the rules laid down cover every point so thoroughly, and the sytem of inspection is so rigid that a low factor is warranted, as the resulting pressures are within safe limits, all things considered.

Design Transmission.

A German physicist by the name of Korn has developed, so it is claimed, a new and improved system of electrically transmitting photographs, drawings, etc., through the medium of selenium.

REPORT OF THE COMMITTEE ON PROGRESS.*

BY T. COMMERFORD MARTIN.

(*Continued from page 332.*)

Details were made public last year in France of tests of a new type of arc lamp, like the Bremer, and of the method elaborated by Blondel of arranging and treating the carbons. The carbons are constructed in several zones or layers, and the mineral admixtures which are fusible salts chosen for their luminous capacity, are incorporated in considerable proportions with the carbon in the inner zones. The outer zone is formed of pure carbon, and it is stated that it protects the carbons against lateral combustion, and also gives them the necessary conductivity. The arrangement of the electrodes is such that a very highly mineralized carbon is placed below another less mineralized, thus producing the result that the arc between the two is constantly situated below, and in the axis of a disk of refractory material. The latter disk serves as reflector and also to prevent the arc from climbing up on the upper electrode. The table shows that a lamp of 3.3 amperes gives 1.5 times more light than a 10 ampere lamp of the old style and 6.5 times more than a 3.3 ampere old-style lamp.

At a recent meeting of the Vienna, Austria, Electrical Society there was exhibited a new incandescent lamp patented by Just, which is claimed to represent an exceedingly important progress in electric lighting, since the lamp is to use only half the current per candle required by the carbon-filament lamp. Such lamps have been built for 30 candles and 110 volts to two watts per candle. Two such lamps of 30 candles were exhibited by the speaker. The commercial manufacture of the new lamp, "the filaments of which are treated with an addition of boronnitride," is said to be neither more difficult nor more expensive that that of carbon-filament incandescent lamps. To a question whether lamps for 16 candles and 110 volts have been made, it was said that the manufacturers have not yet succeeded in building this normal type, but they hope to be able to do so in the near future. The manufacture of 16 cp. lamps for voltage up to 50 volts, is however, already possible.

THE INCANDESCENT LAMP INDUSTRY.

It is only fitting that this report should

*Abstract of report read before the National Electric Light Association at its 27th Convention, held at Boston, Mass., May 24-27, 1904.

mention the commemoration this year of the twenty-fifth anniversary of incandescent lighting in America, and the foundation of the Edison medal, to celebrate the event, in the American Institute of Electrical Engineers. This medal is to be awarded annually to the student producing the best thesis or record of original search, in our colleges, and a fund of over $7,000 was readily raised from among Mr. Edison's associates, friends and admirers. The banquet in New York last February to celebrate the occasion was one of the most notable electrical events of the kind. In speaking of the growth of the industry, Mr. Edison said recently that the production in this country of incandescent lamps had reached a total of about 250,000,000, or 10,000,000 annually since 1879. The present American consumption, it may be added, is about 45,000,000, and the productive capacity of existing factories is about 65,000,000. As to the technical and commercial progress in the period, Mr. John W. Howell says: "The exhaustion of lamps by mercury pumps required from four to six hours in 1881. Improvements in pumps and methods reduced this to one-half hour in 1895. Since then, by simple piston pump and 'chemical exhaust,' a much better result is produced in one minute. The cost of exhausting a lamp at the end of 1882 was considerably greater than the total cost of a lamp at the present time. All the glass-working operations have been changed from hand work by 'glass blowers' to machine work by unskilled labor. The labor cost of the principal glass operation are now a little more than 10 per cent. of the cost in 1882. Until 1894, Edison filaments were made from a bamboo piece passing through eight separate hand operations. Now squirted cellulose is used. In this department we now employ 83 operators. If we should go back to bamboo fiber we should require over 2,150 operators for the same production. The cost of photometric measurements is now 9 per cent. of the cost in 1882, with a great gain in accuracy. The lamp in 1880 contained at least 30 times as much platinum as the lamp of the present day. The amount and cost of glass and other materials used have been greatly reduced. The lamps made at Menlo Park for the steamship Columbia in 1880 consumed about 100 watts for 16 candles. To-day the standard 16 cp. lamp consumes 50 watts. The useful life of a 50-watt lamp to-day is undoubtedly longer than was the useful life of the 100-watt lamp of 1880, and while we have no data for a correct comparison showing the improvement that has taken place, we can get a good idea of it from the fact that the estimated useful life of a 100-watt, 16 cp. lamp made to-day is over 10,000 hours, which is about as many times the probable useful life of the 1880 lamp as the number of elapsed years."

COMPARISONS WITH GAS.

A report was made recently of the public lighting done for the city of Westminster, London, England. It includes tests of the various illuminants there used, both as to their actual candle-power and their cost, and embraces arc lamps and various forms of gas burners, ranging from mantle burners worked under high pressure down to common flat-flame burners of the type generally discarded in this country. The report containing the data is the fifth quarterly report on the subject, so that the lighting may fairly be said to be under systematic test. The tests are reduced to a candle-power-year basis and range from 92.6 cents per candle-year for the flat-flame gas burners down to 18.8 cents for the best arcs and 18 24 cents for the intensive mantle burners. Perhaps the most striking fact brought out is the relatively uneconomical result attained by the ordinary mantle burners. The cost per candle-year for these lamps was just about 34 cents, or, roughly, 50 per cent. more than the average cost with arc lamps. This increase seems to be mainly due to the high cost of maintenance, which amounted to between $5 and $6 per year for each burner.

From Germany comes a little controversial data over an official report of Seggel and Eversbusch concerning the best lighting system for the Bavarian public schools and in favor of incandescent gas light. To counteract this, the Schuckert Company presented another report by Lehmann-Richter, giving the results of comparative tests with two arc lamps or 14 gas incandescent lamps in a school-room. The illumination was good in both cases and sufficiently uniform. The electric light did not deteriorate the air nor increase the temperature considerably. With gas incandescent light the temperature at the height of the pupil's eye was increased three hours about 6 degrees, while the carbonic-acid contents of the air was increased five times. This is thought to be more than permissible for sanitary reasons. The cost of operation of the Welsbach lights is smaller than that of the arc light in the beginning, but after a short use the cost of operation of the Welsbach mantles becomes as high as that of the arc light.

According to the United States Census Office figures, the electric-lighting industry has already caught up with that of artificial gas, and there is no sign of any slackening of pace so far as electricity is concerned. As to the status of gas, some suggestive data compiled by Mr. Alton D. Adams, as to Boston, will be of interest, especially as the city where we meet has been so prominent as a field of water-gas activity. Discussing figures that need not be reproduced here, he says: "Water gas, starting with only 12 per cent. of the total volume of gas sold in Boston in 1890, increased rapidly to 90 per cent. of the entire volume in 1894. From the fiscal year last named to that of 1899, inclusive, the percentage of the water gas made to the total product sold was never below 90, and in two instances stood at 97. During these five years water gas substantially displaced coal gas in the local field, but not in one of them did its brilliant illuminating power or alleged low cost of manufacture check the expansion of electrical supply. In only two years out of the five was the total volume of gas sales materially raised, and then the increase was due to free gifts of gas stoves. These stoves appear to have raised the annual consumption of gas about 75,999,999 feet, which would leave the volume of gas yearly burned for illumination just about stationary from 1890 to 1899 inclusive. Now, a stationary consumption of gas for illumination in the face of an increasing population means an actual decline in the use of gas per capita for that purpose. It is highly probable that this is just the situation which the Boston gas interests have to face. For the decade from 1890 to 1900 the increase of population at Boston was 25 per cent. If the fifty-odd thousand gas stoves now used in the city are doing much baking, it seems hardly probable that illumination by gas has kept pace with the population. Consideration of the years 1900 and 1901 has been reserved until this point because they present several new and interesting conditions in the gas and electric field. For the first time during the 11 years under consideration, gas sales show a substantial gain without the aid of an artificial stimulus, like gifts of gas stoves. This gain in the volume of gas sold for 1901 was 12 per cent. over the volume for 1899. Strange to tell, however, while the total volume of gas was going up, that of water gas, the cheap, brilliant illuminator, went rapidly down. From 96 per cent. of the total volume of gas sold in 1890, water gas fell to only 37 per cent. of the like volume for 1901." Incidentally, it may be mentioned that the gain of

electricity in the period named was 23 per cent. as compared with the 12 per cent. for gas. It may also be added that in some other figures Mr. Adams has shown for Massachusetts an increase in central-station dynamo capacity from 1888 to 1900 of 6,842 kilowatts to 68,941 kilowatts, a tenfold increase, with 15.8 times increase in the connected capacity of lamps and motors.

At the last meeting of the Ohio Gas Light Association, the subject of high-pressure gas in street lighting was discussed by Mr. J. J. Knight, who said: "All things considered, the most efficient, satisfactory, and therefore most generally adopted street lighting system in use to-day is probably that furnished by the use of the so-called 2,000 cp. open electric arc lamps, hung from 20 to 30 feet from the ground and in the center of the street intersections the long way of the block and alternate intersections the short way of the block. The lamps so placed are usually about 500 feet apart, except in what may be called the police districts, where they are placed somewhat closer. A better system, except for the matter of expense, would be the use of the inclosed electric arc lamps placed, say, 200 feet apart on alternating sides of the street, hung from 12 to 15 feet high. There may be earnest gas men who will not agree with these statements, and who believe that single-mantle gas lamps of the modern type placed at short intervals are more satisfactory. It is possible that such would be the case if they were frequent enough, were well maintained, and were not subject to disability and damage from frost, wind, bugs, etc., and the cost of installation, operation and maintenance did not exceed the cost of electricity. I am quite sure that, as a general proposition, the electric light is more favorably regarded by the average citizen not interested in gas, and it is probably not wise to let our enthusiasm lead us astray in this matter." All the same, Mr. Knight plans to ask his home city of Kalamazoo, Mich., to let him try some high-pressure gas lighting with three-mantle lamps. It may be noted that at Kalamazoo the city council has proposed to abandon its municipal electric light plant and contract with a private company for street service. In commenting on the Knight proposition, our own past-president, Mr. Henry L. Doherty, said in the discussion: "I think you will have a greater competition from other forms of electric street lighting than from the inclosed arc lamps, and that we ought to keep in mind the fact that we have to do something better than to beat the inclosed arc lamp. The series open arc lamp, were it to be operated upside down, with a properly designed reflector, would, to my mind, undoubtedly give very much better results than could be secured by the inclosed arc lamps. I think, in spite of the fact that the Nernst lamp does no give as high an efficiency as is ordinarily claimed by the manufacturers of the lamp when considered as a source of light in every direction from the lamp, it can be used in smaller units, and as the light decreases in reverse ratio to the square of the distance, the minimum illumination is, perhaps, greater for the same consumption of watts than any form of arc lighting, even though the total flux of light is less. The Cooper Hewitt mercury vapor lamp, I believe, is the most promising lamp for street lighting at present. But if I were competing for a street lighting system myself, I think I should prefer to use some system of smaller units, either the Nernst lamp or something of that sort, in preference to the inclosed arc lamps, and I should be much inclined to the Cooper Hewitt lamp for street lighting purposes. We have to do something better than compete with the inclosed arc lamp, and while we are able to secure a great deal of street lighting with the ordinary incandescent gas lamp, we may have a harder time to do that in the future, unless we increase the efficiency of the incandescent gas lamp."

(To be continued.)

Made Photograph With Pitchblende.

A press dispatch from Minneapolis, Minn., says that an interesting experiment has been made with radio-active ore by a photographer of that city. A photograph was made from the light emitted by the ore, in a closed box, which excluded all other light. The resulting "shadowgraph" is similar to those made with the X-ray, and proves the strength of the light rays emitted by the ore.

The ore was brought to Minneapolis by E. P. Townsend, of Collinwood, who recently returned home after several years spent in Northern Colorado. The region is, so far as is known, the only place in the United States where radio-active ore exists. It is found in two mines—the Wood mine, of which Mr. Townsend was formerly one of the lessees, and the Kirk mine. Both lie in Leavenworth gulch, in Gilpin County, about 50 miles northwest of Denver.

The ore from which the photograph was made is pitchblende. containing 55 per cent. uranium. This ore is worth $3 50 a pound. The ore holds considerable copper and other minerals with a trace of gold. Radium is generally found in uranium bearing ore. It is only within a few months, however, that the presence of radium in the ore from these mines was demonstrated by the investigations of a professor of the University of Colorado. Thus far no attempt has been made to extract the radium, but the companies operating the two mines plan to do so. The radium salts can be extracted without impairing the value of the ore for the extraction of other constituents.

The photographer who made the radium picture experimented several days in his efforts to obtain a good photograph. He first made the mistake of underestimating the amount of light emitted by the ore and gave the plate too long an exposure. This was a natural mistake, as the light from the pitchblende is not visible to the naked eye even in the dark. The photograph made was given 48 hours' exposure, and this was evidently too long for perfect results. In taking the photograph he laid a key and two coins on a dry plate and then upon these a piece of ore, 4 inches long, 2 inches wide and a little more than an inch thick, weighing one and one-fourth pounds. He tried the experiment of printing from a negative by means of radium light, used as natural light, but found that the rays passed through the film, and left no impression, acting similarly to X-rays.

Proposals Invited.

The Navy Department. through the Bureau of Yards and Docks, is inviting sealed proposals until July 9 for furnishing and installing two 750 kw. steam turbo-generator units at the Boston Navy Yard. Specifications will be furnished by the Bureau, or may be seen at the navy yard named.

The War Department, through the Corps of Engineers, is inviting sealed proposals until July 11 for boilers, engines, generators, cable and conduit for electric light and power plants for the U. S. Engineer's office at Boston. Information will be furnished upon application to Lieut. Col. W. S. Stanton, Boston.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until July 12 for furnishing the Navy Yard at Pensacola, Fla., with arc light poles, switchboards, wire, conduit and fittings, electrical supplies, etc. Blank proposals will be furnished upon application to the Bureau at Washington.

Philadelphia A. I. E. E. Elect Officers.

The annual meeting of the Philadelphia branch of the American Institute of Electrical Engineers was held last week at the

Engineers' Club and the following officers were elected: President, Horatio A. Foster; secretary and treasurer, H. F. Sanville; board of managers, J. F. Stevens, C. W. Pike and Paul Spencer.

Correction About N. E. L. A. Membership Rates.

Editor ELECTRICITY.

SIR: I regret to say that the stenographer made a serious error in his abstract of the amendment to the constitution, and the rates for the different classes of membership as given by him were incorrect. I am therefore inclosing herewith an abstract of the new membership classes and rates. Yours very truly,

DUDLEY FARRAND, Secretary.

MEMBERSHIP CLASSES AND RATES.

At the 27th Convention of the National Electric Light Association, held in Boston May 24-27, an amendment to the constitution was adopted dividing the membership into six classes, as follows:

Class A, member companies—Private corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use, entrance fee, \$25; annual dues for companies in towns of less than 20,000 population, \$10; 20,000 to 300,000, \$25; over 300,000, \$50.

Class B, members—Officers or employes of member companies, elected and continued from year to year with the written consent of the member company with whom connected, entrance fee, \$5; annual dues, \$5.

Class C, instructors and teachers of engineering and related sciences—No entrance fee; annual dues, \$4.

Class D, associate member companies—Electricians, electrical or mechanical engineers, manufacturers, corporations or individuals, who are directly or indirectly interested in advancing the interests of electricity, entrance fee, \$25; annual dues, \$20.

Class E—Officers and employes of Class D, elected and continued by written consent of the Class D member employer, entrance fee, \$5; dues, \$5.

Honorary members.

Electric Light Association Formed.

The Michigan Association of Electric Light Managers was lately formed in Detroit. E. F. Phillips, assistant manager of the Edison Illuminating Company of that city, was elected president, and F. S. Hubbell, of Milford, secretary. Several committees were appointed, and when they have had time to make reports the association will get down to a permanent basis.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 15, 1904.

Electric Railways and Appliances.

762,297. Third-Rail Insulator. Henry L. Fritze, Jersey City, N. J. Filed Oct. 27, 1903.

762,318. Conductor and Collector for Electric Railways or Tramways. Donald Kempt, Buenos Aires, Argentina. Filed March 11, 1903.

762,319. Contact-Box and Conductor for Electric Railways or Tramways. Donald Kempt, Buenos Aires, Argentina. Filed Sept. 23, 1903.

762,379. Trolley-Wheel. John S. Briggs, Los Angeles, Cal. Filed April 25, 1903.

762,380. Traction-Engine. Wellington M Brown, Laporte, Mich., assignor of one-half to Sheldon Rinehart, same place. Filed March 31, 1904.

762,509. Electric Block-Signal System. Louis C. Werner, Dryden, N. Y. Original application filed Dec. 12, 1901. Divided and this application filed Aug. 14, 1902.

762,669. Insulated Rail-Joint. George A. Weber and Percy Holbrook, New York City, assignors to the Weber Railway Joint Manufacturing Company, same place. Filed Nov. 13, 1903.

762,670. Automatic Street-Car Indicator. Frank H. Wehrmann, St. Louis, Mo., assignor, by direct and mesne assignments, to the American Automatic Indicator Manufacturing Company, same place. Filed Oct. 27, 1903.

762,686. Electric Railroad-Crossing Signal. Thomas C. Clark, Cambridge, O. Filed Dec. 29, 1903.

762,749. Trolley. Rowley K. Ortt, Reading, Pa. Filed Nov. 4, 1903.

762,791. Trolley-Hanger. Montraville M. Wood, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 15, 1902.

762,792. Electric-Railway Apparatus. Granville T. Woods, New York City, assignor to the General Electric Company. Filed Oct. 12, 1901.

762,798. Railway Signaling System. Marion A. Born, Lawrenceville, Ga., assignor of part to Milton H. Loudon, Kansas City, Mo., and Narcissa Hayes and Emma Byles, Washington, D. C Filed Nov. 7, 1902.

762,823. Trolley-Wheel. Stewart J. Hanlin, Allegheny, Pa. Filed March 29, 1904.

762,831. Trolley-Base. Peter D. Milloy, Buffalo, N. Y., assignor of one-half to Washington L. Altee, same place. Filed Oct. 27, 1902. Renewed March 29, 1904.

Electric Lights and Appliances

762,503. Electric-Arc Lamp. Geza Szuk and Wenzel Hackl, Budapest, Austria-Hungary. Filed June 3, 1903.

762,720. Portable Electric Light. Conrad Hubert, New York City. Filed Jan. 25, 1904.

Electrical Machinery and Apparatus.

762,358. Electric Meter. William Stanley, Great Barrington, Mass., assignor to the Stanley Instrument Company, same place. Filed Dec. 6, 1901. Renewed Jan. 11, 1904.

762,409. System of Motor Control. George H. Hill, Glenridge, N. J. Filed June 25, 1902. Renewed Nov. 3, 1903.

762,410. Safety Apparatus for Use with Overhead Electric Conductors. Herbert F. Hill, London, Eng. Filed June 10, 1903.

762,535. Electric Plug or Socket Extension. William H. Kelsey, Cambridge, Mass. Filed Oct. 9, 1902.

762,574. Electrical Sparking Igniter for Explosive-Engines Arthur J. Bradley, Oakland, Cal. Filed April 7, 1903.

762,621. Magnetically-Operated Switch. Arthur C. Eastwood, Cleveland, O. Filed July 27, 1903.

762,622-623. Magnetic Clutch. Arthur C. Eastwood, Cleveland, O. Filed March 5 and April 1, 1904.

762,671. Automatic Potential-Regulator. William S. Andrews, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 1, 1902.

762,675. Multiple-Pole Voltmeter-Switch. Charles C. Badeau, Schenectady, N. Y., assignor to the General Electric Company. Filed July 27, 1901.

762,684. Connector. Frank E. Case, Schenectady, N.Y., assignor to the General Electric Company. Filed Oct. 3, 1902.

762,697. Reactance-Coil. John J. Frank, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 16, 1902.

762,709. Electric Motor. Gaylord C. Hall, New York City. Filed March 7, 1901.

762,738. Automatic Regulator for Motors. Hans S. Meyer, Rugby, Eng., assignor to the General Electric Company. Filed Sept. 4, 1902.

762,744. Means for Regulating Dynamo-Electric Machines. Charles R. McKay, Cincinnati, O., assignor to the General Electric Company. Filed Nov. 23, 1901.

Telephones and Telephone Apparatus

762,279. Telephone Lamp-Jack. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company. Filed Oct. 12, 1901.

762,336. Signaling Apparatus for Telephone Switchboards. Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill., assignors to the Western Electric Company. Filed Feb. 20, 1902.

762,337. Signal for Telephone Switchboards. Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill., assignors to the Western Electric Company. Filed July 2, 1902.

762,338. Relay. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Oct. 27, 1902.

762,341. Earth or Ground Wire Attachment. Joseph J. O'Connell, Chicago, Ill., assignor to the American Telephone & Telegraph Company. Filed March 10, 1904.

762,364. Telephone-Call Instrument. Edward W. E. Tompson, Brookline, Mass.; Ruth H. Tompson, administratrix of said Edward W. E. Tompson, deceased. Filed May 18, 1903.

762,391. Telephone Fire-Alarm System. William L. Denio Rochester, N. Y., assignor of one half to Hobart F. Atkinson, same place. Filed May 11, 1903.

762,432. Supervisory Signal for Telephone-Switchboards. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed May 9, 1902.

762,695. Signaling Apparatus. Ernest A. Faller, New York City, assignor to the Faller Automatic Telephone Exchange Company. Filed Oct. 14, 1903.

762,820. Electric Telephone. Ernst Gundlach, Berwyn, Ill., assignor to the American Telephone & Telegraph Company. Filed Feb. 5, 1904.

Miscellaneous.

762,331. Electric Signal. William D. Marks, Westport N. Y. Filed March 12, 1903.

762,370. Electric Signaling System. Samuel M. Young, New York City. Filed Jan. 19, 1903.

762,425. Electrical Battery. John R Lord, San Francisco, Cal. Filed June 5, 1903.

762,430 Electro-Magnetic Signal. Frank R. McBerty, Evanston, and Frederick H. Loveridge Chicago, Ill., assignors to the Western Electric Company. Filed May 9, 1902.

762,498. Ventilator for Submarine Boats. Lawrence Y. Spear, Greenport, N. Y., assignor to the Electric Boat Company. Filed Oct. 20, 1903.

762,644. Electric Key Selecting and Striking Mechanism. Andrew J. Leonard, Denver, Col. Filed Feb. 21, 1902.

762,665. Electrotype or Type Carrier for Printing-Forms. Edward Stine, Plainfield, N. J., assignor to the Tracy Manufacturing Company, New York City. Filed April 22, 1903.

762,715. Electrical Battery. Julias E. Haschke, Chicago, Ill., assignor to Feodor G. Haschke, Austin, Tex. Filed Feb. 8, 1904.

762,751. Separating-Cylinder for Magnetic Separators. Clarence Q. Payne, Stamford, Conn. Filed Aug. 17, 1901.

762,752-753. Apparatus for Magnetic Separation. Clarence Q. Payne, Stamford, Conn. Original application filed Feb. 2, 1902. Divided and last application filed Oct. 3, 1903.

762,759. Magnetic Grapple. Wolfgang Reuter, Wetter, Germany. Filed Feb. 16, 1904.

762,776. Induction Coil Vibrator. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed Jan. 22, 1904.

762,812. Electric Signaling System. John Dianovszky, Passaic, N. J. assignor of one-half to Michael Lujanovitz, same place. Filed July 18, 1903.

762,821. Alarm-Signal. Edward L. Hall and George Hall, Providence, R. I., assignors to the American Equipment Company, Kittery, Me. Filed May 14, 1902.

762,820. Receiver for Wireless Telegraphy. Oliver J. Lodge, Birmingham, Alexander Muirhead, Shortlands, and Edward E. Robinson, Birmingham, Eng. Filed July 28, 1902.

762,847. Storage Battery. Max Schneider, Dresden-Plauen, Germany, assignor of one-half to Julius Belsbarth, Nurenberg, Germany. Filed Sept. 4, 1903.

Reissue

12,228. Storage-Battery Electrode. Johannes Von De Poppenburg, Charlottenburg, Germany. Filed Nov. 12, 1903. Original No. 701,389, dated June 3, 1902.

THE TELEPHONE WORLD.

New York State Independent Meeting.

The annual meeting of the New York State Independent Telephone Association will be held in Buffalo at the Genesee Hotel June 23 and 24. Many matters of importance to the telephone business will be discussed at this conventien, and interesting papers on technical points and the general situation, will be read by delegates well versed in these subjects. Prominent telephone men from other States will be in attendance. There will be a manufacturers' exhibit of telephone apparatus at the hotel during the convention.

Movement for Independent Company in Louisiana.

There is a movement on foot in Breaux Bridge to organize an Independent telephone company to own and operate an exchange in that town and toll lines to St. Martinville and other points in the parish. Enterprising men are behind the movement, and the town council will be petitioned at once to grant a franchise to the local company.

New Telephone Companies for Kansas.

A number of telephone charters were issued this month in Topeka. The list includes the Mahaska Telephone Association, Mahaska, capital $3,500. Chapman Mutual Telephone Company, Chapman, capital, $5,000. Sheridan County Telephone Company, Hoxie, capital $2,000. Barnard Telephone Company, Barnard, capital, $5,000. Albano Telephone Company, St. John, capital $840. Greenwood County Telephone Company, Eureka, capital $33,000. Rural Telephone Association, Delphos, capital $3,000.

The village board of Canastota, N. Y., has voted to grant the Farmers' Telephone Company of that village a general franchise to operate a telephone system within the corporation limits, provided terms can be agreed upon between directors of the company and the municipal authorities. For several years the company has been operating a system connecting farms in the surrounding country. The action of the village board is the first definite step in a movement to establish an Independent telephone system there. It is planned to turn over the property of the Farmers' Company to a Hamilton man, who will operate an exchange in Canastota in competition with the Central New York Telephone Company.

The Keyapaha and Brown County Telephone Company, with head offices in Ainsworth, Neb., held its annual meeting a short time ago, and voted to run a double wire to connecting points to be commenced at once. William Stonicker was elected president; William Davison, vice-president; F. A. Baldwin, treasurer, and W. H. Williams, secretary.

The Hudson River Telephone Company has recently purchased sites for the erection of new exchange buildings at Saratoga Springs, Newburgh and Middletown, N. Y.

The United Farmers' Telephone Company of Westminster: O., has increased its capital stock from $10,000 to $20,000.

Independent Toll Lines for Nebraska Towns.

C. J. Bills is at the head of a new telephone company incorporated in Lincoln as the Western Telephone Company. With a capitalization of a million dollars the concern proposes within a few weeks to establish connections with all the Independent lines that can be reached from Lincoln. Mark Woods, George J. Woods, Frank H. Woods and Thomas H. Ewing are the other incorporators.

Col. Bills says that lines would be run in every direction from Lincoln to connect with other lines everywhere in the State. One line, that to Havelock, is already extended, and this will bring Eastern Nebraska, including Plattsmouth and Nebraska City within easy reach, as the Plattsmouth Independent line already has connections at many points.

Five lines are being arranged for besides this. One line will run northeast toward Sioux City, where other Independent lines will make it possible to reach Minneapolis and St. Paul. Another going southeast toward Falls City, another will tap Saline County, and the towns in that direction; York is the destination of another, and the last will join the Golden Rod line at Davey Within a short time, practically every city in the State that has an Independent system will be in easy communication with Lincoln.

Mr. Bills stated that the new company is wholly distinct from the Lincoln Telephone Company, and although that corporation will reap much benefit from the establishment of new lines, has nothing to do with its management or plans.

Telephone Extension in Minnesota.

The Minnetonka Telephone Company has made some important extensions with its lines this spring A line has been built from the lake to Chanhassen and improvements have been made in the line at Tonka Bay. On the north shore of the lake the system has been reconstructed and all grounded wires have been cut and complete metallic service installed. The line has been extended northwest past Saga Hill and through Bederwood to the head of Crystal Bay. A new station and switchboard have been put in at Markville, giving residents on the north shore direct service with important points on the south side and with the twin cities.

In Excelsior, the headquarters of the system, business has increased remarkably this spring, and many lines have been built. The company's new directory shows an increase in subscribers of about one-third over last year.

The Tri-State Telephone Company is extending its lines west from Minneapolis on the north side of Lake Minnetonka. Several toll stations have been put in. This system is being extended through Willmar to Fargo.

The Automatic Home Telephone Company of Jonesboro, Ark., has been organized with a capital stock of $25,000, of which $3,300 has been subscribed. The company proposes to operate telephone lines in Craighead and adjoining counties. The following have been elected directors: F. C. Watts. R. L. Collins, A. C. Gambell, H. E. Schner and S. A. Daniels.

Independent Company Preferred to Bell in Buffalo, N. Y.

While Buffalo for the fiscal year just closing will have to pay about $4,000 to the Bell Telephone Company for its service, it will have to pay only about $1,320 to the Frontier Company. There are about 130 Bell telephones in the city service and the $1,320 to be paid to the Frontier Company is for 133 telephones. One hundred of the Frontier telephones are free and so actually the city pays only for 33.

As the Frontier Company is giving a cheaper service to the city and has paid a good deal into the city treasury already, the finance committee of the aldermen seems inclined to arrange things so the Frontier Company will get more business and the Bell Company less.

The Frontier Company has submitted a proposition to supply 258 telephones, including the 100 free telephones, for $4,519. As there will be only about $5,500 available for telephones the next fiscal year, it will not be possible to put in many of the proposed additional telephones. But a friendly spirit prevails in the committee toward the Frontier Company, while the Bell Company has not incurred any additional favor from some of the city fathers by insisting on receiving four cents a message instead of giving a flat-rate like the Frontier Company gives. So if some business can be taken from the Bell and given to the Frontier Company, with its flat-rate charge, it is not unlikely that the finance committee will take action to that end.

The Pennsylvania Telephone Company has completed the new line from State Hill to Schaefferstown, using copper wire, which has improved the service considerably. The same company has also commenced repairing the line between Lorah and Reading.

The entire telephone system of Council Bluffs, Ia., has been changed to the common battery, and 1,600 'phones are now connected with the new exchange.

A telephone line is just being completed from Whitesburg to Hindman, Ky. The line goes via Colson and Rockhouse. Several other lines will be extended out from Whitesburg.

The Oceana Telephone Company has become the Lake Shore Telephone Company of Hart, Mich., and its capital has been increased from $50,000 to $200,000.

Telephone Incorporations.

The Cambridge Telephone Company, Cambridge, Me. Capital stock, $10,000. Officers: President, F. J. Hersey; treasurer, D. F. Clark, both of Cambridge.

The Chenango-Broome Telephone Company, North Colesville, N. Y. Incorporators: Charles C. Allen, Greene; F. Watrous, A. L. McIntosh, North Colesville.

The Boone Township Telephone Company, Summitville, Ind. Capital stock, $1,000. Directors: William Sullivan, Scott W. Thurston, H. H. Markle, T. W. Sullivan and James T. Smith.

The Bay City & Matagorda Telephone Company, Bay City, Tex. Capital stock, $5,000. Incorporators: W. W. Boulden, R. H. Traylor, of Bay City; A. W. McNabb, of Matagorda.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Addison, Mich.—The citizens will vote on the question of bonding the town for an electric light plant.

Albany, Ga.—The voters are to decide on the matter of issuing bonds to the amount of $9,000 for electric light purposes.

Athens, Ga.—A new contract has been made whereby the electric lights of the city are to be greatly improved.

Concordia, Kan.—At a recent city council meeting, F. W. Daugherty, president of the local telephone company, read an ordinance to the council asking for an electric light franchise for 25 years. It is the purpose of Mr. Daugherty, and those associated with him, to purchase the present light plant, equip it with modern machinery and new arc lights and establish a day circuit. The matter was referred to the ways and means committee.

Edina, Mo.—F. A. Wilson has sold his electric light plant here to R. M. Peterson, of Rock Springs, Wyo.

Gravette, Ark.—An electric light plant will soon be established here.

Harrisonburg, Va.—The town council has arranged to develop the power of the Rockingham mill for an electric light and power house.

Iowa City, Ia.—An electric light plant will be installed by the J. F. Hill Electric Light Company.

Kalamazoo, Mich.—A special election will be held here June 27 to vote on the proposition to issue $20,000 bonds for an electric lighting plant.

Kingwood, W. Va.—The Irona Coal Company here is going to put in an electric plant and may buy the city plant and furnish street lights.

Lake City, Ia.—The electric light plant here was slightly damaged by a recent fire. The loss is covered by insurance.

Milwaukee, Wis.—Alderman Cary, of the 17th Ward, will introduce a resolution at the next meeting of the council asking the city engineer to give his opinion on the feasibility of establishing small electric light plants at the various pumping stations to be run by the men in charge.

Mooreville, Miss.—A stock company has been formed for the erection of an up-to-date light plant and telephone system. The business men of the town are interested.

Oakdale, Ky.—The American Electric Light Company has been incorporated with a capital of $10,000. C. A. Kess, L. H. Otto and M. A. Rosenfield are the directors.

Philadelphia, Pa.—The scheme to organize a new electric lighting company in this city has not been as successful as its projectors hoped. The project is in charge of George R. Sheldon, of New York, and application for a charter, it is stated, will be made in New Jersey under the name of the Commonwealth Electric Light Company.

Searsport, Me.—The Searsport Electric Light Company, capitalized at $10,000, is a newly organized cocern with H. L. Cram as president, and P. J. Desmond, treasurer.

Seneca, Ill.—The council has made an appropriation of $5,000 for electric lighting of the town.

Shenandoah, Ia.—The People's Electric Lighting Company is asking for proposals for erecting its power plant.

Tazewell, Va.—The Tazewell Electric Light & Power Company has been incorporated with a capital of $15,000. Joseph S. Moss is president.

West Point, Ia.—This city is to vote on the proposition to issue bonds to the amount of $3,000 for an electric light plant.

Wilson, N. C.—The Wilson Light & Power Company has been incorporated with a capital of $125,000, the purpose being to maintain a light and power plant. J. C. Hale and B. F. Lane are interested.

STREET RAILWAYS.

Albion, N. Y.—It is stated that work on the trolley line that will connect Buffalo and Lockport with Rochester is expected to be begun very soon. A. T. Tomlinson, of the engineering firm of J. G. White & Co., of New York, has arrived for the purpose of supervising the work. The John R. Lee Company, of Scranton, Pa., will construct the line. The new line will enter Rochester from the Ridge Road and cars may be running between this village and Rochester by the beginning of next year.

Arnold, Neb.—The Loup Valley Electrical Railway Company has been organized here to build an electric line for freight and passengers between this place and Broken Bow. Power may be obtained from the Loup River. It is proposed to capitalize the concern at $1,000,000. Jacob Miller, representing Denver and Cheyenne capitalists, is interested in the scheme.

Bay City, Mich.—Secretary Persons has announced that a company has been organized and that money had been furnished to build an electric road from here to Caro and Bad Axe.

Boston, Mass.—It is stated that details of the high speed electric railway which is to run between here and Providence are being worked out by a local syndicate of street railway men with which James F. Shaw is identified. It is proposed to utilize the tracks of the Boston & Worcester Electric Company to Newton, and from there the line will run through Needham, Dover, Walpole, Wrentham, North Attleboro, Attleboro and Pawtucket to the city of Providence. Under the charter of the United Electric Traction Company, of Providence, that company is obliged to build to the city limits to connect with any line entering the city, and this will make possible the entrance to that city.

Dallas, Tex.—Application for a charter for a corporation to be known as the Dallas & Eastern Texas Traction Company is soon to be filed at Austin. The purpose of this concern is to construct and operate an interurban line between here and Mesquite, Forney, Terrell, Elmo and Wills Point, a distance of about 40 miles. T. L. Marsalis, W. B. Greenlaw, R. S. Kimbrough and Col. Marshall are back of the enterprise.

Denver, Col.—It is expected that Col. S. B, Dick, of Meadville, Pa., president of the Colorado & Northwestern Railroad from Boulder to Ward, will be here the latter part of this month with a number of his associates. They have $1,000,000 to be spent in improving and extending their road. It is possible that electricity will be used as motive power.

Eminence, Ky.—The Eminence & Newcastle Electric Railroad Company of Henry County, with $150,000 capital stock, has been incorporated by G, W. Young, Newton Bright and L. H. Leber, of this place, and W. L. Nuttall, of Newcastle. The line of road to be constructed will extend from here to Newcastle, 4½ miles, thence northwardly 6½ miles to the Kentucky River.

Minneapolis Minn.—The Pioneer Electric Railway Company, capitalized at $100,000, has been incorporated with the following directors: P. W. McAlister, B. L. Cooper and others.

North Albany, N. Y.—The United Traction Company is installing a storage battery system here. This is being done to afford protection against the road being crippled as it has been several times by reason of the Spier Falls power going off very unexpectedly, leaving the cars on the whole system stalled for some time.

Norwalk, O.—Dan Fox, has the contract for a new trolley road from here to Plymouth.

Oshkosh, Wis.—Work on the proposed Oshkosh, Omro & Berlin Electric Line will soon be commenced.

Point Pleasant, N. J.—The Point Pleasant trolley line may be extended across the Manasquan River and connect at Sea Girt with the Seacoast Traction Road to be run later on to that point.

Richmond, Va.—It is stated that the Chesapeake Transit Company has applied to the corporation commission for authority to increase its capital to $1,500,000 from $1,000,000. The company operates an electric road from Norfolk to Virginia Beach.

San Francisco, Cal.—San Jose and local capitalists have been granted a franchise by Secretary of the Interior Hitchcock to build an electric railway into the Yosemite National Park. This is the first franchise ever granted by the Government for an electric road into any Government reservation. It is announced that work will be begun this summer.

Toledo, O.—It seems probable that there will soon be an electric road to Point Place. J. A. Dunn has presented an application before the commissioners.

Washington, D. C.—A company to build an electric railroad from a point just outside of this city, via Bluemont to Winchester, was formed here lately. S.H. Hansbrough is president; Shirley Carter, secretary, and S. L. Hoover, manager. The building of the new road is contemplated to take place as soon as the franchise is secured.

POWER PLANTS.

La Grande, Ore.—The company that has bought out the La Grande Light & Power Company's plant will within the next 10 months add 150 more horse-power to the plant, which will make it about 300, and reconstruct it entirely, expecting to put all of $16,000 into improvements. The plant was recently sold to J. A. Thornson & Bros., of Dayton, Wash., to be known as the Thornson Stock & Power Company.

Salt Lake City, Utah.—A 2,000 hp. electric plant is to be installed at the Weber Canyon.

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New Telephone Companies for Kansas.

A number of telephone charters were issued this month in Topeka. The list includes the Mahaska Telephone Association, Mahaska, capital $3,500. Chapman Mutual Telephone Company, Chapman, capital, $5,000. Sheridan County Telephone Company, Hoxie, capital $2,000. Barnard Telephone Company, Barnard, capital, $5,000. Albano Telephone Company, St. John, capital $840. Greenwood County Telephone Company, Eureka, capital $33,000. Rural Telephone Association, Delphos, capital $3,000.

The village board of Canastota, N. Y., has voted to grant the Farmers' Telephone Company of that village a general franchise to operate a telephone system within the corporation limits, provided terms can be agreed upon between directors of the company and the municipal authorities. For several years the company has been operating a system connecting farms in the surrounding country. The action of the village board is the first definite step in a movement to establish an Independent telephone system there. It is planned to turn over the property of the Farmers' Company to a Hamilton man, who will operate an exchange in Canastota in competition with the Central New York Telephone Company.

The Keyapaha and Brown County Telephone Company, with head offices in Ainsworth, Neb., held its annual meeting a short time ago, and voted to run a double wire to connecting points to be commenced at once. William Stonicker was elected president; William Davison, vice-president; F. A. Baldwin, treasurer, and W. H. Williams, secretary.

The Hudson River Telephone Company has recently purchased sites for the erection of new exchange buildings at Saratoga Springs, Newburgh and Middletown, N. Y.

The United Farmers' Telephone Company of Westminster; O., has increased its capital stock from $10,000 to $20,000.

Independent Toll Lines for Nebraska Towns.

C. J. Bills is at the head of a new telephone company incorporated in Lincoln as the Western Telephone Company. With a capitalization of a million dollars the concern proposes within a few weeks to establish connections with all the Independent lines that can be reached from Lincoln. Mark Woods, George J. Woods, Frank H. Woods and Thomas H. Ewing are the other incorporators.

Col. Bills says that lines would be run in every direction from Lincoln to connect with other lines everywhere in the State. One line, that to Havelock, is already extended, and this will bring Eastern Nebraska, including Plattsmouth and Nebraska City within easy reach, as the Plattsmouth Independent line already has connections at many points.

Five lines are being arranged for besides this. One line will run northeast toward Sioux City, where other Independent lines will make it possible to reach Minneapolis and St. Paul. Another going southeast toward Falls City, another will tap Saline County, and the towns in that direction; York is the destination of another, and the last will join the Golden Rod line at Davey Within a short time, practically every city in the State that has an Independent system will be in easy communication with Lincoln.

Mr. Bills stated that the new company is wholly distinct from the Lincoln Telephone Company, and although that corporation will reap much benefit from the establishment of new lines, has nothing to do with its management or plans.

Telephone Extension in Minnesota.

The Minnetonka Telephone Company has made some important extensions with its lines this spring A line has been built from the lake to Chanhassen and improvements have been made in the line at Tonka Bay. On the north shore of the lake the system has been reconstructed and all grounded wires have been cut and complete metallic service installed. The line has been extended northwest past Saga Hill and through Bederwood to the head of Crystal Bay. A new station and switchboard have been put in at Markville, giving residents on the north shore direct service with important points on the south side and with the twin cities.

In Excelsior, the headquarters of the system, business has increased remarkably this spring, and many lines have been built. The company's new directory shows an increase in subscribers of about one-third over last year.

The Tri-State Telephone Company is extending its lines west from Minneapolis on the north side of Lake Minnetonka. Several toll stations have been put in. This system is being extended through Willmar to Fargo.

The Automatic Home Telephone Company of Jonesboro, Ark., has been organized with a capital stock of $25,000, of which $3,300 has been subscribed. The company proposes to operate telephone lines in Craighead and adjoining counties. The following have been elected directors: F. C. Watts, R. L. Collins, A. C. Gambell, H. E. Schner and S. A. Daniels.

Independent Company Preferred to Bell in Buffalo, N. Y.

While Buffalo for the fiscal year just closing will have to pay about $4,000 to the Bell Telephone Company for its service, it will have to pay only about $1,320 to the Frontier Company. There are about 130 Bell telephones in the city service and the $1,320 to be paid to the Frontier Company is for 133 telephones. One hundred of the Frontier telephones are free and so actually the city pays only for 33.

As the Frontier Company is giving a cheaper service to the city and has paid a good deal into the city treasury already, the finance committee of the aldermen seems inclined to arrange things so the Frontier Company will get more business and the Bell Company less.

The Frontier Company has submitted a proposition to supply 258 telephones, including the 100 free telephones, for $4,519. As there will be only about $5,500 available for telephones the next fiscal year, it will not be possible to put in many of the proposed additional telephones. But a friendly spirit prevails in the committee toward the Frontier Company, while the Bell Company has not incurred any additional favor from some of the city fathers by insisting on receiving four cents a message instead of giving a flat-rate like the Frontier Company gives. So if some business can be taken from the Bell and given to the Frontier Company, with its flat-rate charge, it is not unlikely that the finance committee will take action to that end.

The Pennsylvania Telephone Company has completed the new line from State Hill to Schaefferstown, using copper wire, which has improved the service considerably. The same company has also commenced repairing the line between Lorah and Reading.

The entire telephone system of Council Bluffs, Ia., has been changed to the common battery, and 1,600 'phones are now connected with the new exchange.

A telephone line is just being completed from Whitesburg to Hindman, Ky. The line goes via Colson and Rockhouse. Several other lines will be extended out from Whitesburg.

The Oceana Telephone Company has become the Lake Shore Telephone Company of Hart, Mich., and its capital has been increased from $50,000 to $200,000.

Telephone Incorporations.

The Cambridge Telephone Company, Cambridge, Me. Capital stock. $10,000. Officers: President, F. J. Hersey; treasurer, D. F. Clark, both of Cambridge.

The Chenango-Broome Telephone Company, North Colesville, N. Y. Incorporators: Charles C. Allen, Greene; F. Watrous, A. L. McIntosh, North Colesville.

The Boone Township Telephone Company, Summitville, Ind. Capital stock, $1,000. Directors: William Sullivan, Scott W. Thurston, H. H. Markle, T. W. Sullivan and James T. Smith.

The Bay City & Matagorda Telephone Company, Bay City, Tex. Capital stock, $5,000. Incorporators: W. W. Boulden, R. H. Traylor, of Bay City; A. W. McNabb, of Matagorda.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Addison, Mich.—The citizens will vote on the question of bonding the town for an electric light plant.

Albany, Ga.—The voters are to decide on the matter of issuing bonds to the amount of $9,000 for electric light purposes.

Athens, Ga.—A new contract has been made whereby the electric lights of the city are to be greatly improved.

Concordia, Kan.—At a recent city council meeting, F. W. Daugherty, president of the local telephone company, read an ordinance to the council asking for an electric light franchise for 25 years. It is the purpose of Mr. Daugherty, and those associated with him, to purchase the present light plant, equip it with modern machinery and new arc lights and establish a day circuit. The matter was referred to the ways and means committee.

Edina, Mo.—F. A. Wilson has sold his electric light plant here to R. M. Peterson, of Rock Springs, Wyo.

Gravette, Ark.—An electric light plant will soon be established here.

Harrisonburg, Va.—The town council has arranged to develop the power of the Rockingham mill for an electric light and power house.

Iowa City, Ia.—An electric light plant will be installed by the J. F. Hill Electric Light Company.

Kalamazoo, Mich.—A special election will be held here June 27 to vote on the proposition to issue $20,000 bonds for an electric lighting plant.

Kingwood, W. Va.—The Irona Coal Company here is going to put in an electric plant and may buy the city plant and furnish street lights.

Lake City, Ia.—The electric light plant here was slightly damaged by a recent fire. The loss is covered by insurance.

Milwaukee, Wis.—Alderman Cary, of the 17th Ward, will introduce a resolution at the next meeting of the council asking the city engineer to give his opinion on the feasibility of establishing small electric light plants at the various pumping stations to be run by the men in charge.

Mooreville, Miss.—A stock company has been formed for the erection of an up-to-date light plant and telephone system. The business men of the town are interested.

Oakdale, Ky.—The American Electric Light Company has been incorporated with a capital of $10,000. C. A. Kess, L. H. Otto and M. A. Rosenfield are the directors.

Philadelphia, Pa.—The scheme to organize a new electric lighting company in this city has not been as successful as its projectors hoped. The project is in charge of George R. Sheldon, of New York, and application for a charter, it is stated, will be made in New Jersey under the name of the Commonwealth Electric Light Company.

Searsport, Me.—The Searsport Electric Light Company, capitalized at $10,000, is a newly organized cocern with H. L. Cram as president, and P. J. Desmond, treasurer.

Seneca, Ill.—The council has made an appropriation of $5,000 for electric lighting of the town.

Shenandoah, Ia.—The People's Electric Lighting Company is asking for proposals for erecting its power plant.

Tazewell, Va.—The Tazewell Electric Light & Power Company has been incorporated with a capital of $15,000. Joseph S. Moss is president.

West Point, Ia.—This city is to vote on the proposition to issue bonds to the amount of $3,000 for an electric light plant.

Wilson, N. C.—The Wilson Light & Power Company has been incorporated with a capital of $125,000, the purpose being to maintain a light and power plant. J. C. Hale and B. F. Lane are interested.

STREET RAILWAYS.

Albion, N. Y.—It is stated that work on the trolley line that will connect Buffalo and Lockport with Rochester is expected to be begun very soon. A. T. Tomlinson, of the engineering firm of J. G. White & Co., of New York, has arrived for the purpose of supervising the work. The John R. Lee Company, of Scranton, Pa., will construct the line. The new line will enter Rochester from the Ridge Road and cars may be running between this village and Rochester by the beginning of next year.

Arnold, Neb.—The Loup Valley Electrical Railway Company has been organized here to build an electric line for freight and passengers between this place and Broken Bow. Power may be obtained from the Loup River. It is proposed to capitalize the concern at $1,000,000. Jacob Miller, representing Denver and Cheyenne capitalists, is interested in the scheme.

Bay City, Mich.—Secretary Persons has announced that a company has been organized and that money had been furnished to build an electric road from here to Caro and Bad Axe.

Boston, Mass.—It is stated that details of the high speed electric railway which is to run between here and Providence are being worked out by a local syndicate of street railway men with which James F. Shaw is identified. It is proposed to utilize the tracks of the Boston & Worcester Electric Company to Newton, and from there the line will run through Needham, Dover, Walpole, Wrentham, North Attleboro, Attleboro and Pawtucket to the city of Providence. Under the charter of the United Electric Traction Company, of Providence, that company is obliged to build to the city limits to connect with any line entering the city, and this will make possible the entrance to that city.

Dallas, Tex.—Application for a charter for a corporation to be known as the Dallas & Eastern Texas Traction Company is soon to be filed at Austin. The purpose of this concern is to construct and operate an interurban line between here and Mesquite, Forney, Terrell, Elmo and Wills Point, a distance of about 40 miles. T. L. Marsalis, W. B. Greenlaw, R. S. Kimbrough and Col. Marshall are back of the enterprise.

Denver, Col.—It is expected that Col. S. B. Dick, of Meadville, Pa., president of the Colorado & Northwestern Railroad from Boulder to Ward, will be here the latter part of this month with a number of his associates. They have $1,000,000 to be spent in improving and extending their road. It is possible that electricity will be used as motive power.

Eminence, Ky.—The Eminence & Newcastle Electric Railroad Company of Henry County, with $150,000 capital stock, has been incorporated by G. W. Young, Newton Bright and L. H. Leber, of this place, and W. L. Nuttall, of Newcastle. The line of road to be constructed will extend from here to Newcastle, 4½ miles, thence northwardly 6½ miles to the Kentucky River.

Minneapolis Minn.—The Pioneer Electric Railway Company, capitalized at $100,000, has been incorporated with the following directors: P. W. McAlister, B. L. Cooper and others.

North Albany, N. Y.—The United Traction Company is installing a storage battery system here. This is being done to afford protection against the road being crippled as it has been several times by reason of the Spier Falls power going off very unexpectedly, leaving the cars on the whole system stalled for some time.

Norwalk, O.—Dan Fox, has the contract for a new trolley road from here to Plymouth.

Oshkosh, Wis.—Work on the proposed Oshkosh, Omro & Berlin Electric Line will soon be commenced.

Point Pleasant, N. J.—The Point Pleasant trolley line may be extended across the Manasquan River and connect at Sea Girt with the Seacoast Traction Road to be run later on to that point.

Richmond, Va.—It is stated that the Chesapeake Transit Company has applied to the corporation commission for authority to increase its capital to $1,500,000 from $1,000,000. The company operates an electric road from Norfolk to Virginia Beach.

San Francisco, Cal.—San Jose and local capitalists have been granted a franchise by Secretary of the Interior Hitchcock to build an electric railway into the Yosemite National Park. This is the first franchise ever granted by the Government for an electric road into any Government reservation. It is announced that work will be begun this summer.

Toledo, O.—It seems probable that there will soon be an electric road to Point Place. J. A. Dunn has presented an application before the commissioners.

Washington, D. C.—A company to build an electric railroad from a point just outside of this city, via Bluemont to Winchester, was formed here lately. S. H. Hansbrough is president; Shirley Carter, secretary, and S. L. Hoover, manager. The building of the new road is contemplated to take place as soon as the franchise is secured.

POWER PLANTS.

La Grande, Ore.—The company that has bought out the La Grande Light & Power Company's plant will within the next 10 months add 150 more horse-power to the plant, which will make it about 300, and reconstruct it entirely, expecting to put all of $16,000 into improvements. The plant was recently sold to J. A. Thornson & Bros., of Dayton, Wash., to be known as the Thornson Stock & Power Company.

Salt Lake City, Utah.—A 2,000 hp. electric plant is to be installed at the Weber Canyon.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12⅝c.; Lake 12⅝@12¾c.; casting, 12⅛@12¼c.

The members of the New York Stock Exchange have voted to close the Exchange Saturday, July 2.

The city of Chicago is to submit a tentative franchise proposition to the Union Traction Company at once.

The first quarterly dividend, 1¼ per cent., on Third Avenue (New York) stock will be paid in July, according to the terms of the lease.

The American Electric & Controller Company, with Dover Del., incorporators, has been chartered to acquire patents that cover electric generators and devices. Capital, $5,000,000.

The Electric Storage Battery Company has declared the regular quarterly dividends of 1¼ per cent. on its common and preferred stocks, payable July 1. Books close June 25 and reopen July 1.

The Chesapeake Transit Company has applied for authority to increase its capital to $1,500,000 from $1,000,000. The company operates an electric road from Norfolk to Virginia Beach, Va.

The usual quarterly dividend of 1¾ per cent. on the stock of the Metropolitan Street Railway Company of New York has been declared, and will be paid on July 15. Books close June 24 and will reopen July 16.

It was reported Saturday that the Brooklyn Rapid Transit Company had sold an additional $2,000,000 of its 4 per cent. bonds, the total authorized issue being $150,000,000. The purchase price was said to be about 79.

The gross earnings of the Hudson River Electric Company, Hudson River Water Power Company, and subsidiary companies for eight months ending June 1 were $298,495. These earnings do not include revenue from the contracts for lighting the cities of Albany and Troy, N. Y.

The Urbana, Mechanicsburg & Columbus (O.) Electric Railway Company on Saturday increased its capital stock from $100,000 to $2,000,000. Senator Foraker has become largely interested in the road. The name has been changed to the Columbus, Mechanicsburg and Western.

The dividend of 1½ per cent. and ¾ extra on the stock of the American Telephone & Telegraph Company, payable on July 15, will include the entire issue of new stock issued in 1903, as the last installment of this issue was payable on May 6, 1904.

It is reported that a plan is being considered by a prominent Wall Street banking firm for a blanket mortgage for the Metropolitan system of New York. It is said that a $150,000,000 authorized issue would be sufficient to refund all Metropolitan outstanding bonds and provide cash for improvements and extensions for the next decade.

The stockholders of the Niagara, Lockport & Ontario Company have voted to increase the company's capital stock from $1,000,000 to $10,000,000 for the construction of the power canal from the Niagara River, under a New York State charter granted ten years ago. It is announced that work on the power canal will be continued.

The New York Stock Exchange committee on securities rules that "assignments of right" with the words "discharged to New York" stamped after the words "Boston certificate," and designating by means of a stamp the Farmers' Loan & Trust Company, New York, as the place for payment of the subscription, will be delivery under the ruling of May 23, 1904, in re General Electric Company "rights."

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price June 20
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	144¾
Metropolitan Street Railway	103⅛
Metropolitan Securities	76¼
Ninth Avenue	195
Third Avenue	118¾
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	48⅝
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	65¼
Philadelphia Traction	96¼
Union Traction, $17.50 paid	50
Boston.	
Boston Elevated, full paid	141
West End Street, com	91
do. do. do. pref	111
Chicago.	
City Railway	175
North Chicago	71
Union Traction, com	5½
do. do. pref	29½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	32
do. do. pref	66
Electric Lead Reduction	⅝
Electric Vehicle, com	9
do. do. pref	12
Westinghouse, com	156
do. pref	194
General Electric	151
Boston.	
Edison Electric Illuminating	235
General Electric	151½
Massachusetts Electric Companies, com	18
do. do. do. pref	70
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	142
National Carbon, com	28
do. do. pref	101½
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	55
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	129
Western Telephone Company	7¼
New England Telephone Company	120⅝
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	86
Miscellaneous.	
Chicago Telephone Company	116
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

Wireless Telegraphy on Excursion Boats.

When an elder goes on an excursion trip with his family a moral as well as a legal agreement is entered into with the steamboat company; to the effect, that the company will guarantee a reasonable degree of safety to those on board, by making use of safety apparatus at its command in the way of life boats, life rafts, life buoys and improved signaling devices.

By defining what is meant by a reasonable degree of safety, sufficient enlightenment might come to the public to enable it to know its rights.

If a reasonable degree of safety is best implied by the use of such devices as expert and public opinion would agree upon as the most modern of their kind, then the adoption and continued use of old-fashioned or worn out types is a trespass on the rights of passengers and should be summarily dealt with by our jurists and juries.

Aside from the merely humane act of supplying life preservers, life boats, etc., adequate to save life in an emergency, for which the law distinctly provides, comes the further responsibility of equipping a vessel with signaling apparatus which does not merely arouse the neighborhood to the fact that danger is imminent but is a reliable means or securing the proper remedy for such a possible catastrophe.

A vessel with a party of excursionists is naturally isolated from ordinary means of communication with the shore. But it *can* place itself in such intimate relationship with the police and fire boat stations along or in the neighborhood of the river front by means of wireless telegraphy, that rapid river service to the scene of the accident or impending disaster, is as hurried as human effort can make it.

What chance is there for people that go on a fishing excursion? Thousands go every year on well-known steamers. No land for several miles and deep water! Supposing the life rafts, life boats and life preservers *are* all right and in full service during a fire. Hundreds of people are then floating around in the water for perhaps many hours before being rescued. With a wireless outfit on board, relief will not be a matter of chance but of certainty. It seems at this writing to be an absolute necessity, one that the law should require as indispensable to public safety.

Red tape, greed and graft have cost a thousand innocent lives. With a horribly awakened consciousness of the necessity for the employment of the most adequate of modern inventions for public safety on excursion boats, the public must not complain if legislation neglects to make it a legal necessity. The public demands the laws that are made; let it require every excursion boat to be supplied with a wireless telegraphic outfit in charge of an expert throughout the busy summer season. Stations on shore to receive the message could send the call to every point of relief in the neighborhood of the vessel. It would certainly be a satisfaction to the million or more excursionists traveling along the bay or river during the season, as well as to the president and board of directors of the steamship company, to know that every means that human ingenuity can command is being employed to avoid the awfulness of death by fire and water. It is not entirely a question of what the law requires, because it is obvious that it does not require enough. It is more of a question of doing our duty to the innocent and helpless entrusted to our care.

Destructor Plants. The June number of a British magazine describes at considerable length the modern methods of destroying town refuse and the manner in which the destructor is made to earn its keep.

It can hardly be maintained that any branch of public administration has a greater influence on the health, and, consequently, on the wealth, of the people, than the removal and destruction of those by-products of animal life and civilized existence, which our gregarious habits have rendered it impossible for us to dispose of, individually, by the natural means which are available in an agricultural commmunity. The necessity of abolishing the ancient methods of the past in favor of the modern method of burning all solid refuse was recognized by the International Congress of Hygiene and Demography, held at Brussels in September, 1903. At this most important gathering of the municipalities, the sanitary engineers, the medical officers of health, and the military authorities of the civilized world, the report dealing with this question received the assent of the Congress in general meeting. In such gatherings as this, ignorance and prejudice find no place, and their offspring, international jealousy, does not raise its head.

The report fully and frankly condemns the various methods of disposal formerly adopted, and recommends the collection by the public authority, and the subsequent destruction by fire, of all those matters which find their way into the ash-bins of the modern dwelling. The dustructor has thus received the sanction of the most representative body of international hygienists ever assembled. While, however, the destructor has come to be regarded as a sanitary necessity, there is another side to the question. The burning of refuse in a thorough and efficient manner evolves a very great heat. Shall this heat be utilized, and, if so, how? Most engineers have no hesitation in saying that so valuable an asset must not be lost. Boilers are, therefore, erected in connection with the destructor, into which the hot gases from the furnace are led. Steam is thereby generated at the highest ordinary pressures, and in quantity sufficient to be of the greatest value in producing power for many purposes.

Although steam is obtained from this low grade fuel, which in many instances is utilized for generating electric current, it is questionable whether a plant of this nature is a paying enterprise looked at solely from a commercial standpoint. The English magazine previously mentioned would lead one so to believe, but if we mistake not a number of the destructor plants in England a few years ago were obliged to do a good deal of account juggling to show a financial profit. But whether a destructor plant gives a monetary return or not it is to be advocated on sanitary grounds.

* * *

Electric Tramway Standardization. The various sub-committees of the English Engineering Standards Committee, to whose work we have on several occasions referred, are continuing their investigations of a number of the problems arising in connection with electrical standardization. The latest event of electrical importance is the holding of a conference, in London, of Electric Tramway Pole makers. The conference was convened by the Standards' Electric Tramway Sub-committee, and the proceedings were presided over by Mr. Alex. P. Trotter, one of the electrical advisers to the Board of Trade, who intimated that a great deal of valuable information had been brought together with the assistance of manufacturers, relating to the proposed standardization of three section tramway poles. This conference was necessitated because the makers were not entirely in accord with the propositions drafted by the committee as the result of the information which had been placed before them. At the meeting the various points were discussed separately and in detail. There was unanimity respecting the classification and the overall length of poles, as well as the length of telescope joints, but different views obtained with regard to the lengths of the sections proposed as standard. Some members advocated, in the interests of economy, that the two top sections should be made ef equal length. There was also difference of opinion respecting the outside diameters of the poles, it being held by some that the figures proposed would not represent the most economical pole which could be produced to stand the stipulated bending tests. The result of this was the decision to increase the suggested diameters by an even amount. The conference carefully went into proposals to standardize similar diameters and over all lengths for both sectional and taper poles, and make their basis interchangeable. The other practical questions which came under consideration included the proposed drop test, bending, and permanent set tests.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

At the annual commencement of Stevens Institute of Technology the honorary degree of Doctor of Science was conferred on Mr. Edward Weston.

Invitations to send delegates to the International Electrical Congress at St. Louis have been sent to thirty national electrical and scientific associations all over the world.

A British patent was issued recently to Prof. Reginald A. Fessenden, which relates to improvements in wave telegraphy.

The New York State Independent Telephone Association has adopted a resolution that its members shall respect the territorial rights of all accredited Independent telephone companies and that there shall be no encroachment.

A dispatch from Washington, D. C., says that in the matter of the charges of Thomas A. Edison against two examiners in the Patent Office, the Secretary of the Interior has decided against Mr. Edison. The findings of Acting Commissioner Moore were that there was no evidence of malfeasance or intentional wrongdoing on the part of the examiners, and that the charges were not sustained and should be dismissed.

There is a good deal of dissatisfaction among Pittsburg holders of Westinghouse Electric over the prospect that another year is to be allowed to pass without the holding of the annual election. There has been no annual meeting held since 1897, and no re-election of a board of directors within that period. Last year when the stockholders authorized the increase of the capital stock a meagre financial statement was submitted, and the intimation conveyed that a full report of the fiscal year would be made this year. The date for holding the annual meetings is June, but no notice has been sent out of a gathering this year, and it is semi-officially reported that none is likely to be made. Several years ago the official explanation was made that the reason a balance sheet and general report were not made annually to stockholders was that the company's business was of a character that to publish a report would be giving information to competitors that might be used to the disadvantage of the stockholders.

The conditions during the past seven

months in Trinidad, Col., caused by the coal strike, have induced the coal companies to make some changes, among them the addition of electrical motors inside the mines and also of electrical diggers. The new motor that was recently placed in one of the mines took the place of about 30 men. The new diggers are getting out 100 tons and more a day. Each one requires two men to operate it, and they receive 5 cents each a ton.

Mr. Cooper Hewitt, who is perfecting his new light, is to have an experimental electrical laboratory 210 feet up in the tower of Madison Square Garden, New York, which is to be remodeled for him at a cost of $10,000.

At the 38th annual convention of the Master Car Builders' Association, held last week in Saratoga, N. Y., Mr. H. H. Vreeland, president of the Metropolitan Street Railway Company of this city, spoke of the advance made by electricity, which he believed would eventually supersede steam for railway motive power. He urged the master car builders to meet the demands soon to be made upon them.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 341.*)

Carrying Capacity of Wires.—If the drop of potential in electric light wires was the only thing to be feared, it would be a matter of concern only to the consumer of electricity and the power company. The candle power would not be up to the standard, and the waste of power in the conducting wires would represent a heavy percentage of the cost of transmission. But this is not all, and the matter is of importance to the community as well, because when excessive energy is wasted in the conducting wires, not only does it become manifest as drop of pressure but as heat. The danger of an unusual rise of temperature in the wires is removed by the limitations imposed on contractors in the United States. These may be found in the National Electrical Code of the Fire Underwriters.

Rubber Covered Wires.—The wire employed in electric wiring is protected by a rubber covering, the name generally applied being "rubber covered wires." A rise in temperature of 30 degrees F. is allowed in such wires, and as this means an increase in resistance and therefore an increase in drop, the following table is given for the purpose of illustrating this fact:

Effect of Temperature upon Resistance of Wires and Drop of Pressure.

1,000 feet No 10 B. & S.=1 ohm.

Current.	Increase in temperature.	Increase in resistance.	Increase in drop.
10	10 degs. F.	.022 ohm.	.22 volts
"	20 " "	.044 "	.44 "
"	30 " "	.066 "	.66 "
"	40 " "	.088 "	.88 "
"	50 " "	.110 "	1.10 "
"	75 " "	.165 "	1.65 "
"	100 " "	.220 "	2.20 "

This table is based upon the increase in resistance in a copper wire due to an increase in temperature. A rise of 1 degree F. means an increase in resistance of .0022 per cent. (nearly ¼ of 1 per cent.) The formula employed is as follows:

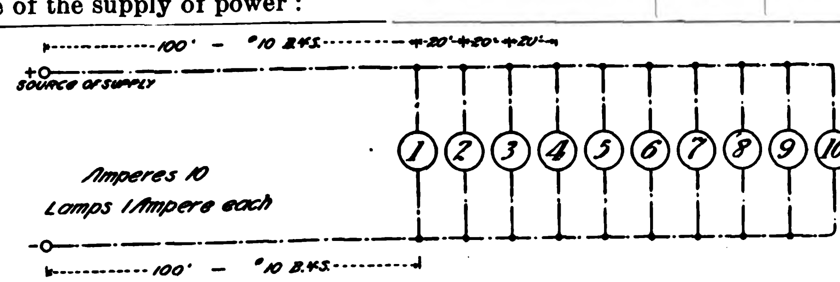
Formula: Resistance at an increased temperature=resistance of wire in ohms × .0022 × rise in degrees Fahrenheit + the resistance of the wire.

To illustrate, supposing a wire has 5 ohms resistance and the rise in temperature is 20 degrees F., what is the resistance? The resistance$=5 \times .0022 \times 20 + 5=5.22$ ohms. The resistance of wires of other metals than copper can be calculated by the same formula provided the constant is obtained from the table of constants given under the heading of "Temperature Coefficients."

Temperature Coefficients.
Percentage Increase of Resistance per 1 degree Fahrenheit.

Percentage.	Metal.	30 deg. F.
.002156	Copper.	.06468
.002517	Iron.	.07551
.000244	German-silver.	.00732
.001372	Platinum.	.04116
.002167	Aluminum.	.06501

Calculation of a Simple Circuit.—Because the lengths of wire connected to each lamp are different, the resistance of each circuit and therefore the drop of pressure is different. In the circuit illustrated, the drop of each lamp becomes greater the further it is removed from the source of the supply of power:



For instance, lamp No. 1 has $100 + 100=200$ feet of wire connected to it, and lamp No. 10 has $200 + 180 + 180=560$ feet of wire in its circuit. The other lamps have lengths of wire in their circuits lying between 200 feet and 560 feet. For this reason it is evident that the resistance in circuit with each lamp is different and therefore the drop is unequal throughout the line. Using No. 10 wire and allowing one ampere per lamp gives the following data:

Circuit of 10 Lamps taking 1 ampere apiece. Size wire, No. 10 B. & S.

Position of lamp.	Feet of wire.	Resistance. Ohm.
No. 1	200	.200
" 2	240	.240
" 3	280	.280
" 4	320	.320
" 5	360	.360
" 6	400	.400
" 7	440	.440
" 8	480	.480
" 9	520	.520
" 10	560	.560

Current in the Wire.—The drop in the wire cannot be calculated by merely multiplying the main current by the various resistances of the various circuits given above. An examination of the circuit will show that the connecting wires of lamp No. 1 carry 10 amperes, while the connecting wires of lamp No. 2 carry 10 amperes and 9 amperes. This unequal distribution of current in the connecting wires which lead up to all of the lamps and the difference in drop in each lamp is shown in the following table:

Distribution of Current in Connecting Wires of a Simple 10 Lamp Circuit.

Position of wire.	Current in wire.	Resistance of wire.	Drop in Volts.
Between source and lamp No. 1	Amperes 10	Ohm. .200	2.000
Between No. 1 and No. 2	9	.040	.360
" 2 " " 3	8	"	.320
" 3 " " 4	7	"	.280
" 4 " " 5	6	"	.240
" 5 " " 6	5	"	.200
" 6 " " 7	4	"	.160
" 7 " " 8	3	"	.120
" 8 " " 9	2	"	.080
" 9 " " 10	1	"	.040

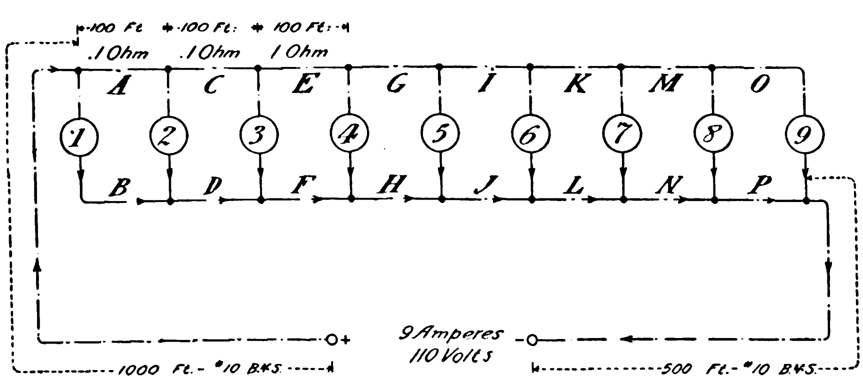
The last column of this table shows the drop due to the current and connecting wires of each lamp, but it does not show the total drop of the lamp. To illustrate,

the first lamp has a drop of 2 volts, because its connecting wires carry the full 10 amperes and have a resistance of .2 ohm. The second lamp, however, is different; its drop is greater, because it not only meets with the drop of the first lamp, but that of its connecting wires lying between lamp No. 1 and 2, equal to .36 volt. Lamp No. 2 therefore has a drop equal to 2.36 volts, and lamp No. 3 will have a drop equal to lamp No. 2 plus the additional drop it experiences in its connecting wires lying between lamp No. 2 and No. 3, amounting to .32 volt, or a total of 2.36 + .32 = 2.68 volts drop for lamp No. 3.

Drop of Each Lamp in a simple 10 Lamp Circuit, Current 10 amperes. Size of Wire No. 10 B. & S.

No. of lamp.	Drop from source to lamp.	Total drop in volts.
	Volts.	
1	2.00	2.000
2	2.00 +. 36	2.360
3	2.00 + .36 + .32	2.680
4	2.00 + .36 + .32 + .28	2.960
5	2.00 + .36 + .32 + .28 + .24	3.100
6	2.00 + .36 + .32 + .28 + .24 + .20	3.400
7	2.00 + .36 + .32 + .28 + .24 + .20 + .16	3.560
8	2.00 + .36 + .32 + .28 + .24 + .20 + .16 + .12	3.680
9	2.00 + .36 + .32 + .28 + .24 + .20 + .16 + .12 + .08	3.760
10	2.00 + .36 + .32 + .28 + .24 + .20 + .16 + .12 + .08 + .04	3.800

It is of the utmost importance to carefully follow the items given in this table and their relation to the main facts. The table shows that in any circuit of the character shown in the illustration the drop increases from the source to the last lamp. Lamp No. 1 has a drop of 2 volts, lamp No. 10 a drop of 3.8 volts, and between these two occur increases in drop, due to the causes above specified.



SKETCH OF WIEDEMANN SYSTEM IN WHICH EVERY LAMP IS CONNECTED TO AN EQUAL LENGTH OF WIRE.

The purpose in view in making an analysis of wiring is to find the best methods to employ in laying out the circuits, for the purpose of keeping the drop as uniform as possible among the lamps. This task can only be accomplished intelligently and therefore economically, for the problem is as much commercial as scientific, by following certain general principles in mapping out the most important circuits.

The Wiedemann System.—The purpose of the Wiedemann system was to connect each lamp in the system with an equal length of wire. By this means every lamp represented individually a circuit of equal resistance, and it was believed that the drop of each lamp would be alike.

By following the length of circuit through each lamp in the sketch it will be seen that each lamp is supplied with current through 2,300 feet of No. 10 wire. Take lamp No. 1 for instance, starting from the positive pole the current passes through 1,000 feet of wire, then through the lamp, then through B, D, F, H, J, L, N, P (which are the connecting wires between lamp and lamp on one side of the circuit of 100 feet apiece) and finally through the indicated 500 feet of terminal wire. The total length met with for lamp No. 1 is therefore 1,000 feet + 800 feet + 500 feet = 2,300 feet total. Tracing the circuit through lamp No. 2 will give 1,000 feet + A + D, F, H, J, L, N, P + 500 feet = 1,000 + 100 + 700 + 500 = 2,300 feet for lamp No. 2. Following the circuit through for each lamp will show exactly the same length of wire connected to each one. If there is the same length of the same size of wire connected to each lamp, the resistance in circuit with each lamp must be the same. The question now arising is this: Will the lamps have equal drop and therefore burn with equal candle power, or is the drop in the circuit of each lamp different? This question can be best answered by an investigation of the drop met with in the circuit of each lamp. To discover the drop in the circuit of each lamp, the resistance and current must be known. In the sketch the resistance is known, so the problem is reduced down to a statement of the number of amperes in each part of the circuit of each lamp.

Amperes in Lamp Circuits.—To find the amperes in each lamp circuit refer to the sketch beginning with lamp No. 1. Because every lamp has the two terminals of the circuit, respectively 1,000 feet and 500 feet to consider alike, they will be left out of consideration for the present and particular attention paid to the current in the connecting wires met with in the circuit of each lamp. Following the 9 amperes along from the + pole it is seen that 1 ampere passes through lamp No. 1 and enters connecting wire B, leaving 8 amperes to pass through connecting wire A. Another ampere passes through lamp No. 2 and enters connecting wire D, returning with the ampere from connecting wire B. The following table will clearly show the distribution of current in the connecting wire of the circuit.

Connecting wire.	Amperes.	Drop in volts.
Positive wire.		
A	8	.1 × 8 = .8
C	7	.1 × 7 = .7
E	6	.1 × 6 = .6
G	5	.1 × 5 = .5
I	4	.1 × 4 = .4
K	3	.1 × 3 = .3
M	2	.1 × 2 = .2
O	1	.1 × 1 = .1
Negative wire.		
B	1	.1 × 1 = .1
D	2	.1 × 2 = .2
F	3	.1 × 3 = .3
H	4	.1 × 4 = .4
J	5	.1 × 5 = .5
L	6	.1 × 6 = .6
N	7	.1 × 7 = .7
P	8	.1 × 8 = .8

It is now a simple task to discover the drop met with in the circuit of each lamp. For instance, lamp No. 1 meets with a drop of .1 volt in B, .2 volt in D, and in F, H, J, L, N and P respectively, a drop of .3 + .4 + .5 + .6 + .7 + .8 volt or a total of 3.6 volts. Lamp No. 1 has its circuit through B, D, F, H, J, L, N, and

P; lamp No. 2 its circuit through A, D, F, H, J, L, N, and P, and lamp Nos. 3, 4, 5, etc., as shown in the following table:

No of lamp.	Circuit of lamp.	Total drop of lamp.
1	B, D, F, H, J, L, N, P,	.1 + .2 + .3 + .4 + .5 + .6 + .7 + .8=3.6
2	A, D, F, H, J, L, N, P,	.8 + .2 + .3 + .4 + .5 + .6 + .7 + .8=4.3
3	A, C, F, H, J, L, N, P,	.8 + .7 + .3 + .4 + .5 + .6 + .7 + .8=4.8
4	A, C, E, H, J, L, N, P,	.8 + .7 + .6 + .4 + .5 + .6 + .7 + .8=5.1
5	A, C, E, G, J, L, N, P,	.8 + .7 + .6 + .5 + .5 + .6 + .7 + .8=5.2
6	A, C, E, G, I, L, N, P,	.8 + .7 + .6 + .5 + .4 + .6 + .7 + .8=5.1
7	A, C, E, G, I, K, N, P,	.8 + .7 + .6 + .5 + .4 + .3 + .7 + .8=4.8
8	A, C, E, G, I, K, M, P,	.8 + .7 + .6 + .5 + .4 + .3 + .2 + .8=4.3
9	A, C, E, G, I, K, M, O,	.8 + .7 + .6 + .5 + .4 + .3 + .2 + .1=3.6

According to the above data lamp No. 5 has the greatest drop and will therefore burn the dimmest. Its loss is 5.2 volts, then comes lamps Nos. 4 and 6 with a drop of 5.1 volts apiece, then lamps Nos. 3 and 7 with an equal drop of 4.8 volts, lamps Nos. 2 and 8 with 4.3 volts drop and finally lamps Nos. 1 and 9 with equivalent drops in pressure of 3.6 volts. The middle lamps burn dimly, the ones on each side a little brighter, ths lamps on each side of these a little brighter, etc. If the number of lamps arranged as shown in the sketch are even, the two middle ones will burn equally bright, the candle power increasing from these two in pairs equally to the two ends of the circuit. An experiment with a bank of 20 lamps connected up as shown on a 110 volt circuit will demonstrate the fall of candle power from the ends to the middle of the circuit. It is therefore evident that in the Wiedemann system although each lamp is in circuit with the same amount of resistance, because the current is different in the connecting wires the drop of each lamp is different from its neighbor as shown.

(*To be continued.*)

THE HUMMING OF DYNAMOS.

Herr J. Fischer-Hinnen, in an article in the *Zeitschrift fur Elektrotechnik* of June 5, investigates the causes of and the remedies for the "humming" of dynamos. This humming noise appears to any considerable extent only in machines with laminated poles and a small number of slots per pole (six to nine) and increases generally as the air-gap decreases. The note given off by various machines was determined by Herr Fischer-Hinnen by means of tuning forks of known frequencies, and it was found that these figures agreed in every case with the number of armature teeth that passed a given point in a second. It may, therefore, be inferred that the sound is produced in the laminated poles by the variations of the flux due to the teeth, and it is evident that the strength of the hum increases with diminishing numbers of teeth per pole. As a result of a number of tests, the author has found that if the equation

$$\frac{b - 0.7r}{(D + 2\delta)\pi} N_1 = \text{a whole number} + 0.5,$$

be fulfilled, then humming will not occur at all or only to a small extent. In the above equation, b = peripheral width of pole shoe, r = radius of the rounded-off portion of pole tip, D = diameter of armature, δ = air-gap, and N_1 = number of slots. Although the above equation was correct with regard to the machines tested, Herr Fischer-Hinnen does not put it forward as being reliable in all cases, as it takes no account of the slot width.—*Electrician, London.*

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

A WINDING MACHINE.

Quite a satisfactory way to make a winding machine is to take an old sewing machine and saw off the arm close to the bearing at the drive end. Saw off the shaft at the desired length and run babbitt into the hollow shank, to make a bearing that will support the shaft. File the shaft down where it is cut off in order to make a head stock for the machine. The tail stock is made of a bolt threaded full length, and made to work through two nuts held in position at each end of a tee. The tee is made of iron piping, and the nuts are held in it by running babbitt around them after being put in place. The diagram shows the construction of the machine.

A piece of the old machine may be used for a face plate, and another for a dog. The machine may be operated either by foot or by means of a small induction fan motor. The fan can be taken off from the motor and a grooved pulley substituted for it. A grooved pulley on the machine and a sewing-machine belt complete the apparatus. Retainer coils on starting boxes, small field coils, arc-lamp

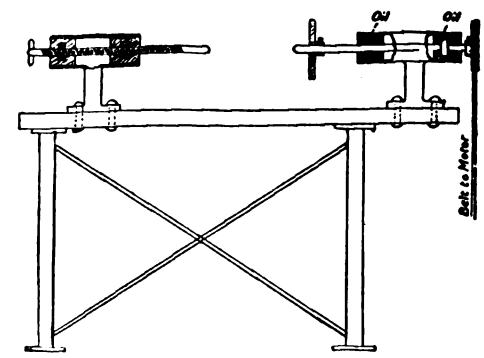


DIAGRAM SHOWING MACHINE AND CONNECTIONS.

coils, meter coils, resistance coils in starting boxes, and other windings, may be wound with this machine. The device will be found very convenient and will afford a great saving of labor and expense.

WM. J. HUGO, Madison, Wis.

PLUGGING A SMALL BREAK OR LEAK IN A STEAM MAIN WHILE IT IS UNDER PRESSURE.

This is probably a "chestnut." Whittle a plug on the end of a long stick, push the plug into the hole where the steam is escaping and then break off the remainder of the stick. In this way the man will be away from the escaping steam.

GEO. B. LAUDER, Concord, N. H.

A TELL-TALE LAMP USED TO KEEP DOWN THE EXPENSE OF CURRENT USED BY THE COMPANY IN STATION LIGHTING.

It is customary among station engineers to go to great extremes to save the expenditure of a few watts wasted energy in designing or buying electrical machinery. After having secured the most efficient machinery possible in a plant, it is the common practice to put as many incandescent lights around the plant as can be conveniently installed. It is a fact that these lighting circuits probably consume more energy than was saved through buying more efficient machines; hence this wrinkle.

In lighting or wiring of stations, and in fact all company property, we make it a practice to control all circuits possible with switches at one central point, and insert in the circuit at the controlling point one standard receptacle into which is inserted a 25-watt incandescent lamp

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

colored red. This lamp, of course, burns whenever the current is thrown upon the lighting circuit, and we find that it has resulted in a very material saving in the amount of energy required to light our various stations and properties.

A red lamp is not at all pleasant to look at, and men working within the vicinity of the lamp will almost invariably make it a point to pull all the switches possible. While this is a comparatively small matter, yet in the course of a year's run it amounts to a great deal of saving; and, as a matter of fact, the original cost of installing these red light tell-tales is almost insignificant.

L. G. WHITE, Columbus, O.

—

AN ARRANGEMENT TO UTILIZE TRANSFORMER-COOLING WATER FOR BOILER-FEED WATER.

The accompanying sketch shows a scheme we have adopted by means of which the consumption of city water on meter basis is materially decreased by turning the water used for cooling the station transformers into the boilers. The system of operation is as follows:

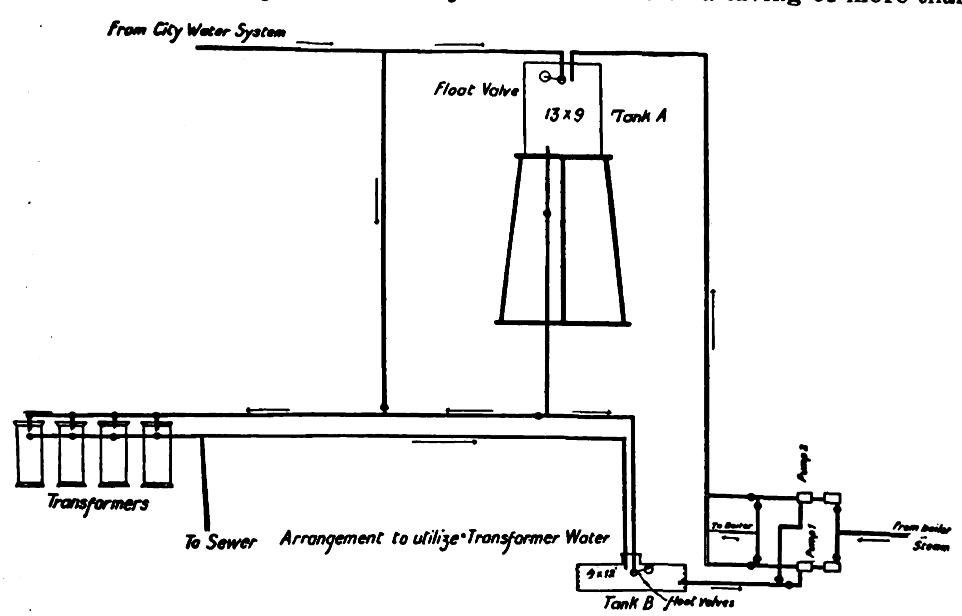


DIAGRAM SHOWING CONNECTIONS.

A large tank A is placed at sufficient elevation above the transformers to insure the necessary head of water to effect circulation in the cooling pipes of the transformers. The waste water of the transformers is carried to a smaller tank B, situated below the transformers, and from this tank the water is drawn into the pumps. The system of piping and valves is such that either pump may feed into the boilers or may feed back into tank A. The water level in tank A is maintained constant through a float valve on a pipe connected with the city water system, the city water system being also connected to the transformers for the purpose of flushing the pipes when necessary. It is also seen that the feed from tank A maintains a constant level in tank B through another float valve. Should the supply of water from the transformers exceed the demand of the boilers for feed water, the idle pump is started up and returns the water from tank B to tank A, thus using the transformer cooling water over and over. Should the demand of the boilers exceed the supply of water through the transformers, the float valve in tank B is open, demanding a supply from tank A, the level in which is in turn maintained at a constant point through the float valve on the city water system. There is also an arrangement, not shown in the sketch, whereby the pumps are operated condensing, in order to raise the temperature of the feed water going to the boilers. This scheme was adopted for the purpose of reducing the supply from the city water system, which is sold to the company on meter basis, and the size of the transformers and boilers is such that the operation has effected a saving of more than 50 per cent. in the consumption of water per month.

GEO. B. TRIPP, Colorado Springs, Col.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE VII.

BY W. H. WAKEMAN.

Formula No. 27 for steel and iron boilers:

$$\frac{(S \div 5) \times T \times J}{R} = P.$$

S = tensile strength in pounds.
T = thickness of plate in inches.
J = strength of riveted joint stated as a fraction of the strength of solid plate.
R = radius of shell.
P = safe working pressure.

My reasons for introducing this formula (coming last in the series for determining the safe working pressure) are as follows:

It is comprehensive because it refers directly to every factor that can influence the result. It can be applied to steel and iron boilers of any known grade by varying the value of S and J to suit given conditions. A conservative factor of safety is used, and by introducing the strength of riveted joint it constantly reminds us that all joints, even of a stated class, are not alike, therefore the value of each must be calculated and used separately if accurate results are wanted.

When presented in the above form it is more easily understood by the young and inexperienced engineer than in any other, but the following will be preferred by many. It can be used at pleasure as its value is not changed. The letters represent the same factors:

$$\frac{S \times T \times J}{R \times 5} = P.$$

Applying the former to the steel boiler already described gives the following safe working pressure:

$$\frac{(60{,}000 \div 5) \times .5 \times .75}{36} = 125 \text{ pounds.}$$

For the iron boiler it gives the following result:

$$\frac{(50{,}000 \div 5) \times .5 \times .75}{36} = 104.16 \text{ pounds.}$$

The following formulas are to be used in connection with No. 27 for determining other values at pleasure:

No. 28:

$$\frac{(S \div 5) \times T \times J}{P} = R.$$

No. 29:

$$\frac{P \times R}{(S \div 5) \times J} = T.$$

No. 30:

$$\frac{P \times R}{(S \div 5) \times T} = J.$$

No. 31:

$$\frac{P \times R}{T \times J} = (S \div 5).$$

No. 32:

$$\frac{P \times R \times 5}{T \times J} = S.$$

Having explained the application of several formulas in this series, it is not necessary to repeat the process as the reader who has followed the plan laid down will be able to apply the five preceding at pleasure, as the letters are explained in connection with formula No. 27.

All of the factors in the foregoing calculations have received due attention and

been fully explained with one exception. That was reserved until the last because it requires more explanation than all others combined. I refer to the factor of safety. Why is it advisable to use so large a factor here? If the bursting pressure of a boiler is 625 pounds, why should the working pressure be limited to 125 pounds? Why is it not safe to carry 500 pounds on it, still leaving 125 pounds as a margin for safety? First, because there is always a chance for hidden defects to reduce the real bursting pressure much more than we calculate on. Second, because the design of many shell boilers is such that we know the actual bursting pressure to be much less than a calculation based on a circular ring cut from the shell of such a boiler determines, and as this is a vital point, it should be of much interest to all concerned, therefore it will be fully illustrated in detail.

A ring cut through the center of dome on the first tubular boiler that I ever had charge of (that I operated for nearly six years) is fairly illustrated by Fig. 11. The top of this dome is not all shown, as it is not necessary. I undertook to drill a hole through the head of it one day, and found quite a long job on hand as it was $1\frac{3}{4}$ inches thick. The only way to get into this boiler above the tubes was through a manhole in this thick cast-iron head, and when we consider the necessary size of such a manhole, also the necessity for another hole for admitting steam to the main pipe, it will be plain that the head was not strong.

A hole about 15 inches in diameter was cut in the shell and nothing whatever was done to strengthen it in this vicinity, although the boiler was made by a firm whose reputation was second to none at that time, and is not now.

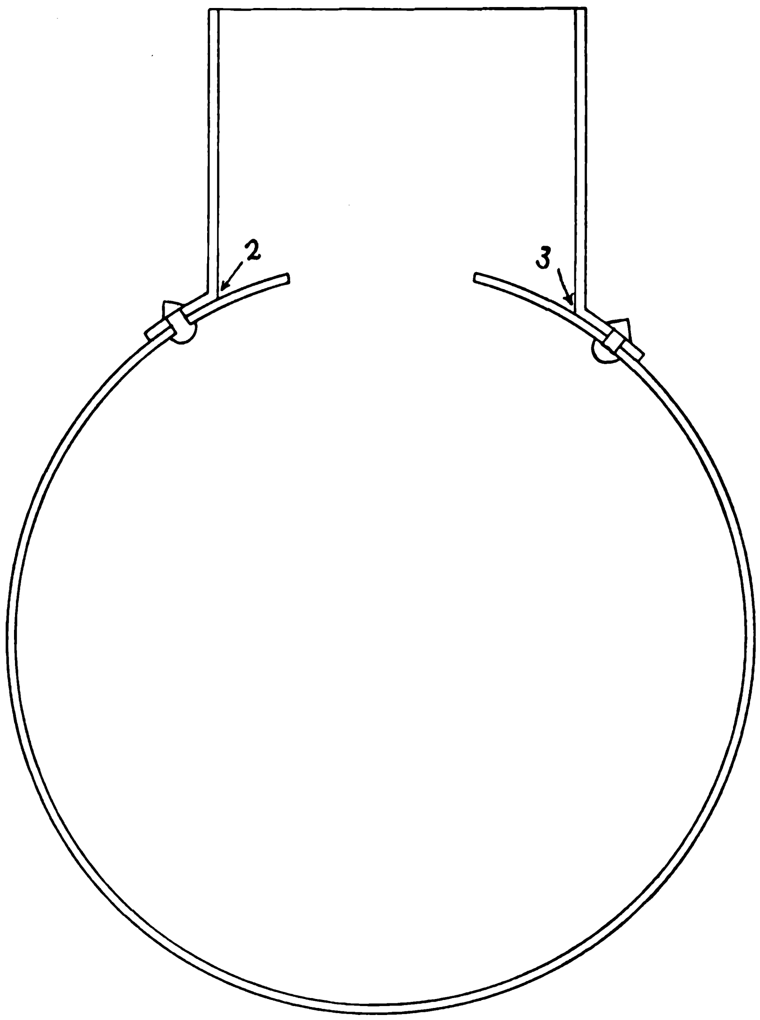


Fig. 11.

As many circular rings 1 inch wide were cut in making this hole, it left a weak place, that was but little stronger than required by the safe working pressure determined by some of the preceding formulas, although it was supposed to be much stronger by those who had not carefully investigated the matter.

Pressure comes upon the rings thus severed the same as upon others, and a portion of it must be carried by adjoining rings in addition to what is legitimately borne by them, which never was and never will be good practice. The result is that engineers in charge of boilers fitted with domes not properly constructed, frequently complain of leakage around the lower seam which they find impossible to stop. This is caused by the dome (and the shell under it) bulging outward under pressure and coming back into place when it is removed.

In another plant I had charge of for more than five years the dome on one of the boilers leaked although it was chipped and caulked by an expert workman. It continued to show distress by leaking until a stiff putty made of red lead and oil was put into the angles at 2 and 3 and allowed to dry before pressure was put upon it, after which it gave no further trouble, although this did not strengthen it.

Much has been written for and against domes, but those who argue against them do not always understand the real reason for their adoption, as they assume that the only object sought in adding one to a boiler is that it may act as a reservoir for steam, and as it does not hold enough to supply an engine for one minute under ordinary conditions, its value in this respect is limited, but unfortunately for the advocates of this idea it is not the most important point in the case.

It is generally admitted by both parties to the controversy that dry steam is expected from a dome, and this is true, but even the most enthusiastic advocate of this appendage cannot tell how a dome can supply dry steam to an engine, if this steam is wet when it enters the dome. The principle which operates to make a dome of any value may be explained as follows: If the end of a pipe is extended down within say 6 inches of the water level in a boiler, and a large quantity of steam is drawn off through this pipe, pressure on the water surface immediately under it will be slightly reduced. Pressure acting on the water surface away from this pipe forces some of the water up into said pipe, thus delivering wet steam to the engine. Of course the quantity of water is comparatively small, but it is enough to be objectionable and unprofitable.

Where a steam nozzle is attached to the shell of a boiler, and the water level is high, the above mentioned principle causes wet steam to pass out. Bearing this in mind it will be at once apparent that the arrangement of nozzle and drum, shown in Fig 12, is of no value whatever in the production of dry steam, for if the water level is high and the boiler forced, water will be drawn up into the nozzle, and having entered the drum it must go to the engine, as no provision is made for disposing of it otherwise.

If this drum was located near the engine it would be valuable as a reservoir for steam, especially if the piston speed

is high, as it would assist in maintaining the initial pressure up to the point of cut-off, but in its present location it is not only of no value, but positively detrimental, as it presents a large surface for the condensation of steam.

In a neighboring plant that I formerly had charge of, two of these drums were removed from boilers by one of my successors and their absence is not detrimental to the service.

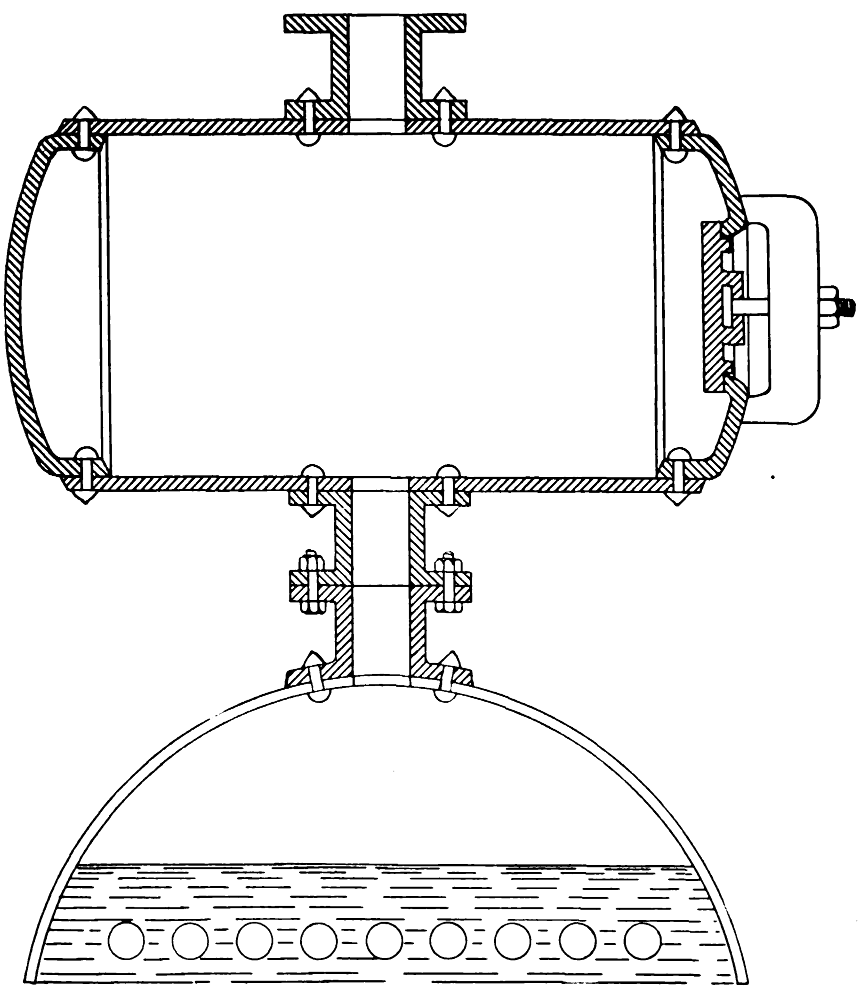


FIG. 12.

Where such a drum is attached to a boiler and it is desired to retain it for any reason, a drip pipe should be connected into the bottom, discharging into the boiler independently of all other connections below the water line. A swing check valve should be provided to prevent water from passing up into the drum.

INTERNAL COMBUSTION ENGINES AND THE DIESEL PRINCIPLE.*

BY W. H. BOOTH.

It is a pity that in his James Forrest lecture Mr. Dugald Clerk should apparently have confined his remarks so much to those engines which are of home origin, because by doing so he omitted much reference to such engines as the Korting, which owes its success to a system of working, the credit of which belongs to Mr. Clerk, and to the Diesel engine, which stands out from all others as the outcome of the latest ideas to internal combustion motors.

It has been pretty conclusively shown that economy in the gas engine attends on high compression, but practice has shown equally conclusively that high compression of an explosive mixture has a low safe limit.

The compression of a gas requires the expenditure of energy, and this energy in the case of a perfect gas is converted entirely into heat energy, and manifests itself by rise of temperature. In a slowly running engine much of this heat could and would pass into the water jacket, and so far would be lost for useful work in the engine. Compressed quickly, as it must be in any engine of moderate size per unit of effort, the gaseous mixture becomes heated to a high temperature, and becomes spontaneous explosive. Myself, I have little doubt that spontaneous ignition takes place more readily in the more highly hydrogeneous mixtures, and this very real danger shuts out from high compression use the richer gases; and those with much hydrogen in their composition, such as the water gases and the coal gases, are unsuitable to be employed in high-compression engines. Mr. Thwaite, in his blast-furnace gas practice, has found that the very poor gas produced from a blast furnace, and containing very little hydrogen, is a very manageable gas. This may partly be due to its considerable constituent of carbon dioxide, which assists to delay ignition. Suffice it to say, that blast-furnace gas will safely endure an intensity of compression above what can be secured with richer and hydrogenous gas.

Now, in the Diesel engine, compression is entirely independent of the quality of the fuel, for the very simple reason that no fuel is introduced until it is wanted to ignite. Pure air alone is compressed, and therefore the intensity of compression is limited only by two factors—the ability of the mechanical construction to withstand the stresses, and the thermal possibilities involved. The high compression produces a temperature sufficient to cause ignition of the fuel, and this ignition takes place as soon as the fuel is introduced to the heated atmosphere in which it burns.

Thus the Diesel engine does act along very different lines from those casual lines of the ordinary internal combustion motor. Though the full cycle intended to be worked by Diesel has not been found practicable, a part of it has been secured, and combustion takes place on isothermal lines, the diagram of the Diesel engine being simply the compression curve pushed forward by temperature, so that the air occupies a larger volume at the same pressure. Thermally, the advantage of this system is that the maximum pressure may be employed that the machinery will permit, and there can be no pre-ignition. There is no sudden accession of pressure on the dead point, but the pressure may even rise a little after the crank has passed its position of zero effort. In this way, therefore, there is less mechanical loss incurred through the imposition of a heavy pressure on the bearings during the time such pressure is producing no turning effort. Where early ignition takes place and produces this effect, much of the heat is passed directly to the water jacket, and therefore wasted. In gas and oil engine work it is of importance that the heat generated by combustion should pass very directly into mechanical work. Every engine is, of course, a compromise between full ignition on the dead point and the longest utilization of the pressure produced, and prolonged combustion, with a minimum of loss to the jacket. Early and complete ignition not

*From the "Electrical Review," London

only produces frictional loss, but jacket loss. These losses are both saved by prolonged combustion, which, by purely academic men is looked on as error. Hence the importance of securing a satisfactory compromise. In the Diesel system this compromise, combined with the principle involved, enables an efficiency to be obtained as between IHP. and calorific capacity of the fuel of 42, if not 44, per cent., and well over 30 per cent. can safely be counted on, referred to brake horse-power.

There is an impression abroad that the mechanical efficiency of all internal combustion engines is low. This is not strictly true as very commonly understood, and it only arises because so many revolutions are made for one working stroke, which has to carry all the frictional effects of idle stroke.

As a machine, the Diesel or other engine may be fully as frictionless as a steam engine, and recent tests of a Diesel engine have shown me that this is the case. I have also found that an indicated horse-power hour can be got for about 0.32 lb. of crude oil with a calorific capacity of about 19,000 B.Th.U., and this points to a very efficient utilization of the heat value of the fuel. This high efficiency is a result due largely, of course, to the high compression which is possible only with the Diesel system of fuel admission. It is also partly due to diminished friction and diminished jacket losses referred to, and these advantages may be more or less secured in other forms of engines than the Diesel.

The economies of recent years in internal combustion engines have all tended towards a diminution of jacket losses. Diesel originally hoped to cut off jacket losses altogether, but this has not been proved possible in practice. A very high piston velocity that would diminish the duration of the heat absorption of the jacket and accelerate the conversion of heat into work, would render the jacket dispensable, but these factors are not yet secured to the necessary extent.

The future improvement of internal combustion engines lies so much along the lines followed by Diesel that this motor may be studied to good advantage, for its system of compression removes the most serious limitations of the ordinary engine, and in weight of combustible per unit of energy output its record is far ahead of any other motor.

Canadian capitalists, including Sir William Van Horne, William Mackenzie and Hon. George A. Cox, have formed the Rio De Janeiro Tramway, Light & Power Company, Ltd., with a capital of $50,000,000, to operate all tramways and lighting companies at Rio De Janeiro, Brazil.

REPORT OF THE COMMITTEE ON PROGRESS.*

BY T. COMMERFORD MARTIN.

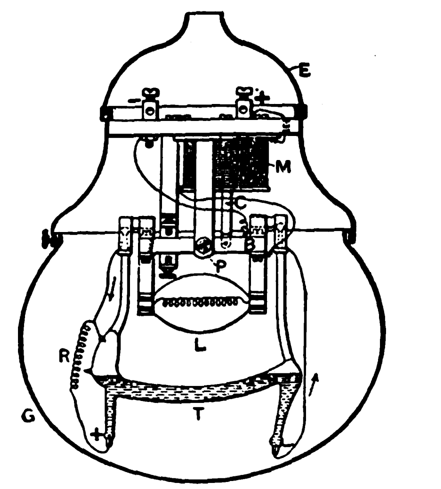
(*Continued from page 346.*)

MERCURY VAPOR LAMPS.

This brings us fitly to the subject of the mercury vapor lamps, in regard to which considerable data are already in print. Since our last report the Cooper Hewitt Electric Company has done a good deal of work introducing this novelty. In fact, in New York City it has ceased to be a novelty, as the lamps are to be seen in many store windows, and are in use in many interiors. Mr. D. P. Cameron, of this company, informs me that for illumination purposes—aside from photography, etc.—they have two types of lamps. One is a 700 cp. consuming 3.5 amperes on 110 volts, and the other 300 cp. running two in series, and consuming 3.5 amperes on 110 volts. The present life averages about 1,200 hours, and on that basis the cost of maintenance averages about one-quarter of the bills for current. These lamps have gone rather on central station circuits than upon those of isolated plants. As another example of American electrical export trade, it may be mentioned that these lamps have been shipped to Sweden, Germany, England, Scotland, Mexico, China and Japan.

An interesting modification of the mercury vapor lamp has been brought out in England, by Bastian and Salisbury. Its efficiency is lower than that of the outright Cooper Hewitt lamp, but it has a convenient form, and the color is appreciably improved.

The engraving herewith shows the lamp in its normal position. E is a spun copper bell-shaped cover which protects the internal mechanism from wet and provides a means for suspending the lamp and fixing the tubes and other devices. G is an ordinary glass globe. As shown in the illustration, the lamp is not at work, and the mercury in the tube T connects the two wires sealed into the glass. Fixed to one end of the glass tube is an iron plunger C, which acts as a core to the electro-magnet M. The resistance R, the electromagnet M, the carbon-filament lamp L, and the mercury in the tube T, are all connected in series. On closing the switch, the core C is drawn up by the electro-magnets; T being pivoted at P and the continuity of the mercury being broken, an arc is formed. The tilting of the tube is thus effected automatically. The pressure of the mercury vapor set up by the arc then forces the mercury up into the left-hand bulb and thus cuts out the auxiliary resistance R. All these



operations occupy but the fraction of a second. The carbon-filament lamp L, just above the mercury tube, is added for the purpose of overcoming the absence of red rays, and this lamp is, therefore, underrun so as to make its radiation rich in the required red rays. An efficiency of 2.5 cp. per watt is claimed when the carbon auxiliary is not used and of 1 to 1.5 cp. per watt when the latter is used. Each lamp requires from 40 to 60 volts and 0.65 ampere, the candle power being 80. Lamps have been run both continuously and intermittently for over 1,500 hours, and the inventors believe that the average life will be about 3,000 hours. The resistance of the carbon filament in series decreases the voltage across the terminals of the mercury tube and consequently the length of this tube. Friends of mine from England not interested in the lamp speak very favorably of its light.

Under the head of vacuum-tube lighting, reference must be made also to the work of Mr. D. McF. Moore, who has continued to apply himself persistently to perfecting applications in this field. His tubes give a very pure white light, and have been adopted for photographic purposes, in the form of movable skylights, the tube being doubled up into a large, flat, window-like box that can be shifted around at will in the photographic studio. In one such window the tube has a length of 43 feet, and is credited with a life of at least 1,000 hours, operating on a basis of 5 cp. per foot, or about 200 cp. total. Similar apparatus has been devised by Mr. Moore for photographic print, and a

*Abstract of report read before the National Electric Light Association at its 27th Convention, held at Boston, Mass., May 24-27, 1904.

good length of tube can also be seen nightly at the entrance of one of the buildings on upper Fifth avenue, New York City.

Some time ago, reflector incandescent lamps were brought out, with the upper half of the bulb silvered for reflector purposes. They do not appear to have remained permanently in the art, but they have proved to be the first step in a most interesting evolution, and to-day in the United States several concerns are introducing special forms of incandescent lamp combined with a shade, so as to give very efficient and uniformly diffused illumination beneath the lamp. One can never tell whether a novelty is just a fad or something that has come to stay, but these reflector lamps have certainly made a decided hit. Possibly the Nernst lamp has helped to stir up improvement in this direction.

A now familiar type of this lamp is that designed by the General Electric Company, and there are several others. It is made with a ground-glass, spherical, tipless bulb about 5 inches in diameter. The aluminum reflector covers the upper half of the bulb, fitting closely thereto, and the junction of the lamp and socket is concealed by a metal collar. The lamp as first designed was made in a unit of 50 cp. consuming from 100 to 120 watts. The introduction of the lamp, however, led to a demand for a smaller unit consuming about the same current as the ordinary 16 cp. lamp, and accordingly a unit just half the candle power and watts consumption of the first one designed has been placed on the market during the year and has proven even more popular than its predecessor. It is made in a smaller diameter bulb 3.75 inches in diameter and is very serviceable for residence lighting, for disk and table illumination. Where the number of outlets permit, it secures a greater uniformity of illumination by distributed lighting with a large number of units than is possible for the same power consumption with the 50 cp. size of lamp.

A year's service of the lamps has introduced a number of improvements, chief among which has been the adoption of a new form of glass reflector in place of the metal reflector. It has the upper surface covered with a fluting of 90-degree prisms. They form a surface which, on the well-known principles of reflection, secures a maximum effect in the downword distribution of light. The shade is translucent and appears radiant with light when the lamp is lighted, thus greatly increasing the attractiveness and artistic appearance of the lamp. The advantage claimed for the shade is that it does not rest upon the lamp, but is suspended from the socket, and is made in such a form as to allow ventilation of the lamp, thus dispersing the heat, increasing the life and maintaining the brilliancy. The present lamp with its new shade therefore, gives considerably longer life and better sustained candle power, equaling and surpassing that of the ordinary 16 cp., 3.1-watt lamp. In introducing this lamp the company has made its first low cost in order to provide an inexpensive unit, and many central stations have placed the lamp on the free-renewal list. They have been able to do this because the renewal of the lamp, when figured on the kilowatt-hour basis, is no greater than that of the ordinary lamp in 8 cp. or 10 cp. frosted bulb—a type of lamp that is regularly supplied free by the majority of central stations.

The use of lamps of the Meridian type greatly simplifies the problems of illumination, as each lamp gives an almost perfectly uniform distribution of light beneath, and this uniform illumination extends over an area having a diameter equal to the height of the lamp above it. This fact provides a simple rule by which the lamps can be properly placed for the uniform illumination of any interior. Another advantage secured is dispensing with the use of ordinary fixtures. The lamp, except with high pitches, can be placed on the ceilings or suspended a few feet therefrom, and in being distributed over the ceiling secures much more satisfactory and uniform illumination than is possible where the lamps are bunched on a fixture in the center of the room. Several lighting companies are using these lamps in clusters as successful competitors of the so-called gas-arcs.

Altogether, the introduction and use of these lamps has tended to improve greatly the art of lighting and to assist greatly central-station lighting companies in their competition with other forms of illumination. An instance mentioned to me recently is that of a railway station on the Jersey Central Railroad. The waiting-room is about 20 x 40 feet. The sole illumination is two 5-inch Meridian lamps at the center of the room and two standard 16 cp. lamps in fixtures at one end. The effect is surprisingly good, and the room is well lit for all practical purposes. The railroad company had originally installed three large-sized chandeliers with six 16 cp. lamps each. These are not now in use at all, the other lamps above mentioned supplying all the illumination.

(*To be continued.*)

MUNICIPAL ELECTRICAL WORK IN ENGLAND.

(From our London Correspondent.)

For considerably more than a year past municipal electrical engineering in England has been under a cloud. The energetic educational and other measures employed by the advocates of freedom for private enterprise in electric lighting and tramway development have had an effect upon the mind of the general public which cannot easily be removed, and partly with a view to putting a braking influence upon excessive municipalization, and partly because their confidence in the security at the back of municipal loans had become appreciably weakened, the men with money to invest have kept it in their tightly-buttoned pockets when municipal opportunities for investment have arisen. Public loans have been placed on the market with tempting rates of interest, and at prices even down to 16 per cent. below par value, by municipal corporations who were anxious to clear off their big overdrafts at the bankers, and who were anxious to meet other liabilities which they had incurred in connection with electricity supply and trolley line systems. And even under such conditions there is anything but enthusiasm on the part of the public, and some recent attempts which were made under the impression that things had now begun to improve have been failures. One cannot open a provincial paper nowadays without finding that this, that and the other city or town will be pleased to sell small portions of stock to anyone desiring to apply, and will give such a rate of interest as will pay the artisan investor far better than his rainy-day balance will earn in the savings banks. And this is the dignified pass to which important British municipalities have been brought in their efforts to conduct electrical and other works on Socialistic lines! The picture, truly, is a sorry one.

It requires no elaborate argument to prove that such a state of things as this carries with it an unfortunate effect upon electrical manufacturing. Generally speaking the electrical manufacturer does not care to any great extent whether he makes his plant, or machinery, or cars, etc., for a municipality, or whether he makes it for a private company. In the former case he knows he will have to wait pretty well until doomsday for his money; and in the latter case he too often has to take part payment of his contract price in speculative securities which he may, or may not, by patiently waiting, be able to unload at a fair figure when the public show some confidence in the undertaking.

In the times of great municipal electrical development, when things were booming a year or two ago, manufactories were pretty general in the carrying out of extensions to meet the continuous flow of business that was looked for from municipal and other directions; but the tightness of money has brought the falling off in municipal contracts, and it has not been possible for company work to make up for the deficiency, for want of confidence in municipal loans has been in a measure responsible for want of confidence in private companies, and they too have been, in many cases, very hard set to raise money to complete their works, or to take new schemes in hand.

It would appear, therefore, that temporarily the anti-municipal electrical agitation has done no one any good whatever. The manufacturer suffers; the private promoters are not benefited by their agitation; municipal systems are handicapped; and useful electrical schemes are deferred. But these are held to be but temporary effects, which will pass away when the present nervous period comes to an end; and it is believed that a time of electrical development in the hands of private enterprise, and on a surer basis, will follow, which will recompense for present unhappy effects. However, we come back to this important fact, that electrical manufacturers are feeling the pinch, and we hear many things about prices being ridiculously under cut, just in order to secure contracts for keeping works going.

A question which during the past few weeks has been commanding close attention in connection with the general subject of municipalization, is that known as the tramway running powers question, and as during the last few days a very important decision has been given by Parliamentary Committees on the point it may be mentioned. The progress of the municipal idea in the electric tramway field has led to the laying down of small purely local trolley lines whose limitations are the limitations of the one particular municipality which had paid for the cost of the system. Little attention has been paid to the importance of interurban communication, and in some cases the tracks are laid on what we might term "freak" gauges instead of the uniformity of contiguous systems being closely studied. Where companies, whose lines have happened to be of similar gauge to a municipal line half a mile or more away, have approached the Municipal Corporation with proposals for intercommunication the attitude taken up has been rather one of scorn than anything else. Hence there has arisen this over-running power controversy and Parliamentary voices have had to be called upon to say whether the municipal obstruction of electric traction facilities was the best thing for the general communities in the matter of passenger and goods transportation. The question has been argued for four or five days, the debate centering around the bill of the Tyneside Tramways Company, which wanted power to run its cars over the lines of the Newcastle Corporation. Both parties had previously met time and time again and had drawn up suggested terms and conditions for an amicable agreement under which intercommunication could become possible, but these negotiations failed and the subject was dissected very fully in the Parliamentary committee-room. Much evidence was produced from the stronghold of municipal tramway managers' offices, the inconveniences and difficulties which the municipal lines would suffer if over-running powers were granted, being stated in detail. But all of this evidence failed to convince the committee that the Corporation obstruction should be allowed to continue and its decision was given in favor of the company. It has, however, yet to be ratified in the Houses of Parliament, and a struggle there is almost certain.

While referring to these questions it may be mentioned that shortly after these lines appear in print the annual municipal electrical convention will be held in England. It opens on June 29 at Derby with an address from the city electrical engineer of that place, Mr. T. P. Wilmshurst, the president for the year. The subjects of the papers are: "The Commercial Practicability of Electric Traction by Surface Contacts," by Mr. C. E. C. Shawfield, the city electrical engineer of Wolverhampton, whose Lorain surface contact lines have been often discussed in the press; "Polyphase Sub-stations," by Mr. S. L. Pearce; "The Financial Position of Municipal Electrical Undertakings," by Councillor Blakeway; "Boiler House Economies," by Mr. R. S. Downe, the city electrical engineer at Southport; "The Organization and Management of the Meter Department" by Mr. A. Cridge; "The Fire at the Bristol Electricity Works," by Mr. H. Faraday Proctor, the Bristol city electrical engineer.

Eight hundred motor equipments have been ordered from the General Electric Company for use on the cars to be employed on the Tokio Street Railway Company's 40 odd mile electric traction system now under construction at Tokio, Japan.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 21, 1904

Electric Railways and Appliances.

762.955. Trolley-Track Rail. William H. Spiller, Aurora, Ill., assignor to the Wilcox Manufacturing Company, same place. Filed Nov. 17, 1903.

762,997. Railway-Switch-Operating Apparatus. Marquis D. Hanlon, Wilkinsburg, Pa., assignor to the Union Switch & Signal Company, Swissvale, Pa. Filed Oct. 8, 1903.

763,016. Ball-Bearing Trolley-Wheel. James A. Norton, Wilkes-Barre, Pa., assignor of one-half to W. L. Raeder, same place. Filed Oct. 22, 1903.

Electric Lights and Appliances.

762,927. Composite Incandescent-Lamp Bulb and Reflector. Otto A. Mygatt, New York City. Filed Jan. 29, 1904.

763,002. Electric-Lighting Apparatus. William Knobloch, New York City, assignor to John Knobloch, same place. Filed Oct. 1, 1903.

763,009. Guard for Incandescent Lamps. Jaris W. Matthews, Bridgeport, Conn., assignor of one-half to James T. Roche, Jr., same place. Filed Dec. 21, 1903.

763,237. Electric-Light Fixture. George H. Young, Elmira, N. Y. Filed April 2, 1904.

Electrical Machinery and Apparatus.

762,957. Partial Circuit for Electric Currents. Guion Thompson, Duluth, Minn., assignor to the Thompson Safety Appliance Company. Filed Aug. 2, 1902.

762,988. Electrical Drive for Centrifugals. William L D'Olier, Philadelphia, Pa. Filed Nov. 9, 1901.

762,993. Circuit Interrupter for Jump-Spark Coils. Charles H. Fischer, Cincinnati, O. Filed April 11, 1904.

763,031. Electric-Motor Controller. Walter N. Vance, Chicago, Ill., assignor to the Miehle Printing Press & Manufacturing Company, same place. Filed June 29, 1903.

763,046-047. Pneumatic System of Motor Control and Motor-Control System. Fred B. Corey, Schenectady, N.Y., assignor to the General Electric Company. Filed Dec. 5, 1902.

763,071. Motor-Control System. Charles L. Perry, Schenectady, N. Y., assignor to the General Electric Company. Filed July 22, 1903.

763,108. Electric Brake. Frank C. Newell, Wilkinsburg, Pa., assignor to the Westinghouse Air Brake Company. Filed April 1, 1902.

763,168. Current-Regulator. Justus B. Entz, Philadelphia, Pa., assignor to the Electric Storage Battery Company. Filed May 7, 1903.

763,169. Condenser. Thomas M. Eynon, Philadelphia, Pa., assignor to the Eynon-Evans Manufacturing Company. Filed April 2, 1902.

Telephones and Telephone Apparatus

763,093. Telephone-Directory. Frederick Drowns, Malden, Mass. Filed Jan. 29, 1904.

763,332. Relay. Burdette S. Smith, Elyria, O. Filed Feb. 14, 1903.

Miscellaneous.

762,881. X-Ray Apparatus. William B. Churcher, Cincinnati, O., assignor to Kennon Dunham, same place. Filed April 11, 1904.

762,882. Secondary Battery.. James P. Clare, Quincy, Mass. Filed Oct. 31, 1902.

763,082. Telegraph-Transmitter. Joseph F. X. Trotier, Montreal, Can. Filed July 29, 1903.

763,151. Process of Electrically Extracting Essential Oil. George D. Burton, Boston, Mass., assignor to the Boston Leather Process Company, Portland, Me. Filed June 27, 1898.

763,164. Apparatus for Determining the Length of Waves and Observing the Oscillations in Electric Oscillating Systems. Johannes Donitz, Berlin, Germany, assignor to Gesellschaft fur Drahtlose Telegraphie, G. M. B. H., same place. Filed Sept. 15, 1903.

763,321. Storage Battery. Henry C. Porter, Waukegan, Ill., assignor to the Porter Battery Company, Chicago, Ill. Filed Nov. 25, 1901.

763,322. Battery-Plate. Henry C. Porter, Waukegan Ill., assignor to the Porter Battery Company, Chicago, Ill. Filed July 14, 1902.

763,330. Electric Furnace. Charles P. E. Schneider. Le Creusot, France. Filed Dec. 22, 1903.

Reissue

12,232. Connection-Counter for Telephone-Exchanges. Charles E. Scribner, Jericho, Vt., assignor to the Western Electric Company. Filed May 25, 1904. Original No. 680,890, dated Aug. 20, 1901.

12,235. Recording Electrical Measuring Instrument. Edward Weston, Newark, and Adelbert O. Benecke. Vailsburg, N. J. Filed Aug. 6, 1903. Original No. 713,257, Nov. 11, 1902.

THE TELEPHONE WORLD.

Kentucky Company Buys Franchise.

The trustees of Whitesville, Ky., have sold a franchise granting the privilege of building a telephone system in that town to the Home Telephone Company of Owensboro, which will at once begin the construction of an exchange there. The location is a promising one, and it is expected to start off with 50 subscribers. The Home Company is now engaged in building an exchange at the Maceo Power Station. The switchboard is being installed, and soon a large number of the telephones will be operating. In addition the Home Company has a large force of men at work extending the lines of its West Louisville exchange to Delaware and Beech Grove. Extensive additions are also being made by this company to its Stanley, Sorgho and Ensor exchanges.

Apparatus will shortly be received for adding fully 40 per cent. to the capacity of the Owensboro Home exchange. It was expected earlier, but the demand upon the Independent Telephone manufacturers, it is claimed, has been such that they are months behind in their orders.

An Old Town to Have Its First Telephone Line.

A new telephone line, which is to connect Leonardtown, Md., with the rest of the county and the outer world, is said to be an assured fact. The Southern Telephone Company will construct the line and has announced that it will connect Mechanicsville by way of Laurel Grove and Morganza with Leonardtown. The construction of the new telephone line will be started on as soon as the material for the work can be obtained

The new line will put Leonardtown, the county seat of St. Mary's County, in touch with the rest of the country. For a hundred years, more or less, the town has existed without either telegraph or telephone service.

Prompted by a desire to stimulate the business to the suburban districts of Philadelphia, Pa., the Bell Telephone Company has reduced its pay station rates from 10 to 5 cents a call. For the present it is not likely that the same reduction will be made in the more populated sections of the city.

The Citizens' Telephone Company of Lansing, Mich., is sending out circulars advising subscribers that after July 1 the rate for exchange service on residence telephones will be $18 a year. The increase is from $12.

The Michigan State Telephone Company is building a new line from Hartford to Benton Harbor, on which there will be four circuits. Two new circuits are also to be added between Hartford, South Haven and Kalamazoo.

With a capitalization of $3,000 the Stafford Telephone Company, of Stafford, N. Y., has been organized with Jay Lathrop, J. A. North and H. E. Ganiard, of that place, as directors.

The United Telephone Company is introducing a number of improvements. At Tamaqua, Pa., it is about to put up nine spans of wire, or a total length of about 1,350 feet. At Schuylkill Haven it is putting up a stub for a guy line.

Telephone Business Progressing in Nova Scotia.

According to a recent consular report from Halifax progress is being made in the use of improved telephones there. A new line of long-distance telephone with 292 miles of copper wire has been opened between Halifax and Sydney, the offices being equipped with the standard relay-energy system, including the latest improvements. The reports of the Nova Scotia Telephone Company show that in the province of Nova Scotia there is one telephone in use for every 88 inhabitants. In the city of Halifax there is one to every 27 persons, while in other towns the proportion is between 20 and 30.

The report of the general manager of the Nova Scotia Telephone Company shows 790 miles of poles for its long distance lines, and 2,246 miles of copper wire. The total mileage of telephones wires in the province is 7,136, and the total miles of posts is 791.

The number of telephones in the province is 3,260, of which 1,801 are in Halifax. Last year the company transmitted 14,000,000 messages.

Meeting of 'Phone Construction Men.

Representatives of the construction department of the Pennsylvania Telephone Company from 38 counties of Pennsylvania and two counties of New Jersey met in convention last week in Harrisburg.

The object of the meeting was for the discussion of business methods to be pursued in the future.

The Illinois Central is to expend $500,000 in reorganizing and improving its system. Wires weighing 400 pounds to the mile will be substituted for those of 175 pounds, now in use. This, with improved instruments: it is hoped, will make conversation between Chicago and the Gulf as easy as taking across a small room. The telephone system is also to be extended over the Omaha division.

It is stated that the British postoffice telegraph department has under consideration the question of substituting female for male operators for working the telephone service at night when the time comes for the department to take over the National Company's undertaking.

The Chicago Telephone Company has declared the regular quarterly dividend of 2½ per cent. on the capital stock, payable June 30. No action was taken on the expected issue of new stock.

The Farmers' Telephone Company of Blaine, Me., is still extending its lines and is putting in many new instruments. The line extends into New Brunswick and will also be built to Houlton and Presque Isle.

The city council of Eustis, Fla., has granted a telephone franchise to H. W. Bishop, giving him a 20-year concession with liberal privileges.

The Bell Telephone Company, of Philadelphia, has declared the regular quarterly dividend of 1½ per cent. payable July 15 to stock registered July 5.

Wide Range for Independents.

Within two months people of Pittsburg, Pa., can talk over an Independent line with friends at any of the Atlantic coast summer resorts in New Jersey, with Philadelphia, Harrisburg, Baltimore, Johnstown, Akron, Wheeling, Indianapolis, Columbus, St. Louis, Kansas City and thousands of intermediate points.

The last connecting link of the system covering the eastern and central western parts of the United States with a network of Independent lines are being built. For the connection with the East there remains now but a short stretch east of Johnstown. For the Western connections a straight line is well under way to Wheeling, connecting there with the People's Telephone Company. From Wheeling a line is to be built to Barnesville, there connecting with existing lines of the United States Telephone Company. The line extends across Ohio to New Carlisle, on the western side of the State. From New Carlisle to a point just over the border in Indiana another new line will be built, connecting with Indianapolis and with other Western cities.

The Pittsburg & Allegheny, an Independent company, is taking a prominent part in the extension work. It ranks as one of the largest single concerns, and the recent trip of the capitalists back of it through the West resulted in the formation of close working arrangments with its fellow Independents,

The Pittsburg & Allegheny has entered McKeesport within the past month with a telephone proposition which is new in Pittsburg. Without any charge a telephone is installed in house or office. It is operated with a slot, and for 5 cents a call local or county service is given. The company is ending the first month of its campaign with 1,000 subscribers in the Tube City.

The Lumenburg, Va. Telephone Company has extended its lines to Keysville, where it will connect with the Charlotte Company, and will cover several counties. The extension to Blackstone will be commenced in a few weeks.

Telephone Incorporations.

The Oxford Valley Telephone Company, Oxford, N. Y. Capital stock, $1,000. Incorporators: Ward B. Gofford, George B. Fletcher, John J. Lillis, all of Oxford.

The Scircleville Telephone Company, Scircleville, Ind. Capital stock, $6,000. Stockholders: Charles Lewis, Nathaniel Cripe, William H. East, Giles W. Trask and others.

The Telephone Transmitter Guard Company, Chicago, Ill.—to manufacture telephone attachments. Capital stock, $10,000. Incorporators: Robert D. Famion, William R. Hartley and J. Henry Kaft.

The Deer Creek Mutual Telephone Company, Independence, Okla. Capital stock, $50,000. Directors: W. R. Cooper, J. W. Grigsby, Charles Peterson, I. M. Nelson, all of Independence, and C. M. Collins, of Seven Oaks.

The Dassel & Collinwood Telephone Exchange Company, Dassel, Minn. Capital stock, $25,000. Officers: President, S. N. Gayner; vice-president, J. J. Levarez; secretary, George W. Hudberg; treasurer, E. E. McGraw.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Asheboro, N. C.—This town has contracted with J. D. Ross, to furnish electric lights for the streets.

Bern, Ind.—The Bern Electric Light Company has been incorporated with a capital of $6,000. The directors are H. H. Stucky, H. S. Michand and others.

Cleburne, Tex.—Word has been received from L. W. Dunn, the promoter of the proposed electric street railway and electric light and power plant, saying that there would be a change in the plans as first suggested: that if the mayor and board of aldermen would grant a franchise, he and his associates would put in a first-class electric light plant and street car system without selling stock.

Collins, Ia.—This town has decided to put in a system of electric lights, and a franchise will no doubt be granted.

Earl, Ark.—This town, located 26 miles west of Memphis, Tenn., on the Iron Mountain Railway, is now the property of the Earl Improvement Company, which was recently capitalized at $75,000 under the laws of this State. The officers of the company are B. A. Shepherd, president; Felix T. Pope, vice-president, and H. A. Morrison, secretary and treasurer. The new owners will put in a system of waterworks, electric lights, etc.

Greene, Ia.—A company has been organized here to purchase and operate the electric light plant.

La Grange, Ga.—The city council lately voted to issue $25,000 bonds for the constructing and equipment of an electric light plant. The matter is to be submitted to the people first.

Lebanon, Pa.—A representative of Lovegrove & Co., of Philadelphia, has been here trying to organize an electric light plant. He solicited for half of the stock, the remainder to be controlled by Lovegrove & Co.

Lewistown, Pa.—The Lewistown Electric Light Company is having plans drawn for a new power plant.

McKinney, Tex.—The election held here June 14, to vote on the question of issuing bonds to the amount of $8,000 for the purpose of installing and operating an electric light plant, was carried.

Morrisonville, Ill—The Morrisonville Electric Company, of this city, has been incorporated with a capital of $6,000 to operate a heat, light and power plant. The incorporators are William Lewis, J. F. Lewis, T. C. Cloyd and others.

Myerstown, Pa.—An effort is being made to organize an electric light company here. A number of those interested in the project held a meeting, but nothing definite has as yet been developed.

Newberry, S. C.—The commissioners of public works have recommended to the city council that the power house be equipped with a new engine and electrical apparatus in order that more light may be had.

Newport, Ky.—An ordinance has been submitted to the mayor relative to the submitting to a vote of the people at the November election, the matter of erecting a new electric light plant.

Oxford, N. C.—An election was recently held here for the purpose of submitting the question of the establishment of electric lights and waterworks to the people. The vote was unanimous for light and water. Edward Frost, of Salisbury, will own and operate the plants and the town will pay $3,500 annually.

Rapid City, Mich.—W. C. Clement, who owns water power a mile out from here, expects to install an electric lighting plant for the purpose of lighting this city, Ogden and Crystal Beach.

Royalton, Minn.—The village council is considering a municipal electric lighting plant.

Sioux City, Ia.—The matter of the city owning and operating its own electric light plant is to be decided at a special election to be held soon.

Thomaston, Ga.—It was lately voted to issue bonds for electric lighting and waterworks purposes.

Whitehall, Mich.—The citizens have voted to bond the village for $75,000, for enlarging the electric light plant and constructing a wharf.

STREET RAILWAYS.

Belvidere, Ill.—J. M. Roach, general superintendent of the local traction company of Chicago, has announced that a new electric line would be constructed between here and Elgin, and other points, making a complete system from Chicago to Freeport.

Butte, Neb.—There will probably be an electric railroad from Anoka to Springfield. It will be backed by C. A. Johnson, of this city.

Fargo, N. D.—The Fargo & Moorhead Street Railway Company is considering a trolley line project to Detroit.

Lansing, Mich.—Articles of incorporation have lately been filed by the Flint & Saginaw Traction Company, capitalized at $35,000,

Lexington, Ky.—It was lately announced that J. B. Haggin, the millionaire turfman, would soon complete a private electric track from the front gate of the Elmendorff farm to his residence. Arrangements have been completed to connect it with the Paris & Lexington interurban line.

Marion, O.—Charles Linn is interested in the proposed electric line between here and Bucyrus.

Mount Vernon, N. Y.—Petition has been made by the local taxpayers' association that the New York Subway Commission extend its line to the southerly boundary of Mount Vernon, so as to accommodate a large number of local residents who have business in New York. The plan is to charge 5 cents for a continuous trip from here to City Hall or intermediate points and the running time will be 45 minutes.

Muskogee, I. T.—Plans were lately matured whereby an electric street car line is to be built here at once.

Owosso, Mich.—E. R. Tinney, of Detroit, is at work securing the right of way for the Ionia-Owosso Electric Railroad.

Paul Smiths, N. Y.—The surveys have just been completed for an electric road between here and Lake Clear, at the junction of the Adirondack division of the New York Central and the Saranac Lake and Lake Placid branches of this road. The distance to be covered by this road is 7 miles. The power of the new railway will be developed at Franklin Falls, in the Saranac River, about 15 miles below the village of Saranac Lake, and 25 miles distant from this place. Wires will be strung through the villages of Saranac Lake and Lake Placid for the purpose of supplying light and power to the people of those places.

Pryor Creek, I. T.—Representatives of the Oklahoma & Cherokee Central Electric Railway Company were in town and left a proposition to build through here for a bonus of $25,000. The company is composed of Pennsylvania capitalists, who are largely interested in the Cherokee oil fields.

San Jose, Cal.—An electric railway is to be erected from this city to Berryessa. An executive committee has been appointed for the purpose of aiding Mehling & Lockwood, the promoters of the enterprise, in securing the right of way. The road will be of standard gauge, and will run from the heart of this city to Berryessa, a distance of 5 miles.

Sterling, Ia.—The Sterling, Dixon & Eastern Electric Railway Company is trying to secure the right of way from here to Morrison.

West Chester, Pa.—A charter has been granted the West Chester, Uwchland & Pottstown Street Railway Company, capitalized with $144,000. The length of the road is 24 miles, and it will run through the townships of West Goshen, West Whiteland, Lower and Upper Uwchland, West Vincent, East Nantmeal, South Coventry and North Coventry. County Surveyor MacDonald will construct the line. C. Wesley Talbot, of this city, is president.

Willimantic, Conn.—The Willimantic Traction Company will build a line between here and Baltic.

POWER PLANTS.

Dallas, Tex.—The Dallas Light & Power Company has plans completed for the immediate erection in this city of a power plant to cost, when completed, about $500,000. The plant will be modern, consisting of new machinery, buildings, etc., and the whole to be ready for use within a year's time. The old steam engines now in use will be replaced by steam turbines.

Duluth, Minn.—The Great Northern Power Company, of this city, has finally succeeded in financing its project for the development of the water power of the St. Louis River, 20 miles above here. The first installation will be of 45,000 hp., 30,000 of electric power, and 15,000 of direct hydraulic. The capacity of the electrical development is above 100,000 hp., and subsequent developments will be made later. The expenditure of $3,000,000 will be called for, and work is expected to begin shortly.

Front Royal, Va.—A new electric power plant is proposed for this place.

Springfield, Ill.—A new power plant for the interurban road is to be erected at Riverton. Work is to be commenced soon.

BIDS WANTED.

Wayne, Neb.—The city council has authorized the city electrician to receive bids for the purchase of a new dynamo, engine, and also to prepare plans for the other proposed improvements to the plant.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12⅝c.; Lake 12⅝@12¾c.; casting, 12⅛@12¼c.

Philadelphia Union Traction goes on a 4 per cent. basis July 1.

It is estimated that the July interest and dividend disbursements payable in New York will foot up a total of $147,500,000, against $142,800,000 last year and $139,500,000 in 1902.

Stone & Webster, Boston, report that a dividend of $3 per share has been declared on the preferred stock of the El Paso (Tex.) Electric Company, payable July 11.

The Westinghouse Electric & Manufacturing Company has declared the regular quarterly dividends of 2½ per cent. each on its preferred, assenting and non-assenting stocks, payable July 11. Books closed June 27 and will reopen July 12.

The National Gas, Electric Light & Power Company has filed, at Trenton, N. J., a certificate increasing its capital stock from $10,000 to $4,000,000, of which $2,000,000 is common and $2,000,000 preferred, with 6 per cent. dividend on the preferred stock.

Articles of incorporation have been filed for a new electric line between Chicago and Milwaukee. It is named the Chicago & Milwaukee Electric Railroad Company and the capital stock is $300,000. The directors and incorporating stockholders are all Chicago men.

The directors of the United Traction Company of Albany, N. Y., have organized by the re-election of John W. McNamara as president and Robert C. Pruyn chairman of the executive committee. All the other officers were re-elected.

The Underground Electric Railways Company of London (Eng.) has applied to the London Stock Exchange to allow $17,996,000 five per cent. profit-sharing secured notes, to be quoted in the official list, in lieu of the fully-paid provisional certificates now quoted.

It was announced Saturday that the New York City Railway Company, lessee of the Third Avenue Railroad Company, will pay on July 30 to the stockholders of the Third Avenue Railroad Company the first quarterly dividend of 1¼ per cent. payable on the stock of that company under its lease to the Metropolitan Street Railway Company. The present plan is to close the books of the Third Avenue Company for this dividend on July 13.

President Winter of the Brooklyn Rapid Transit Company made a vigorous denial of the rumors that the company was selling bonds at the present time. Mr. Winter said that there was no truth whatever in the reports, and that the company was not even considering a bond sale. The stockholders of the company have authorized a bond issue of $150,000,000, but thus far only about $5,000,000 has been sold. The reason for the bonds being kept out of the market at present is the poor investment demand.

J. & W. Seligman & Co. of New York City have notified the holders of the Connecticut Railway & Lighting Company's first and refunding 4½ per cent. 50-year gold bonds that an agreement and supplemental mortgage dated June 23, 1904, has been executed between the United Gas Improvement Company, the Connecticut Railway & Lighting Company, and the Colonial Trust Company. Under the agreement the firm agrees to guarantee by indorsement the interest on the bonds of the Railway & Lighting Company, of which $15,000,000 have been authorized and $10,269,000 are outstanding.

ELEOTRIOAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price June 27
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	147¾
Metropolitan Street Railway	103⅛
Metropolitan Securities	77
Ninth Avenue	195
Third Avenue	118¾
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	48⅛
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	65¼
Philadelphia Traction	96¼
Union Traction, $17.50 paid	50
Boston.	
Boston Elevated, full paid	141
West End Street, com	91
do. do. do. pref	111
Chicago.	
City Railway	175
North Chicago	71
Union Traction, com	5½
do. do. pref	29½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	32
do. do. pref	66
Electric Lead Reduction	⅝
Electric Vehicle, com	9
do. do. pref	12
Westinghouse, com	156
do. pref	190
General Electric	150
Boston.	
Edison Electric Illuminating	235
General Electric	155
Massachusetts Electric Companies, com	19½
do. do. do. pref	73
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	142
National Carbon, com	28
do. do. pref	101½
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	55
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	130½
Western Telephone Company	7
New England Telephone Company	121½
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	..
Western Union Telegraph Company	87¾
Miscellaneous.	
Chicago Telephone Company	116
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

POSITIONS VACANT.

FREE ADVERTISING.

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It is the desire of the management of this paper to bring the unemployed and employer together to their mutual benefit, and to this end they invite the former to make use of this column without charge. No advertisement exceeding five lines (about 35 words) will be inserted, but advertisers may write fully of their qualifications and these letters will be kept on file for future reference in filling vacancies which may occur.

Applicants should write clearly and distinctly and enclose postage to secure attention.

Address all communications to Free Advertising Editor, "Electricity," New York.

SITUATIONS WANTED.

FREE ADVERTISING.

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Address all communications to Free Advertising Editor, "Electricity," N. Y.

WANTED—Position by first-class electrician, at present employed at World's Fair, St. Louis; 6 years' experience; best of reference. Address
W. H. E., care Electricity.

WANTED—Position by a married man, 34 years' old; understand all trolley and telephone construction, two and three phase, inside and outside wiring, T.-H. arc lamp testing and trimming; have good references as to my working ability and soberness. Address M. C., care Electricity.

WANTED—Position by young man, aged 22, as chief or assistant chief electrician in an electric power or lighting station; have had 3 years' experience around electrical machinery; can do all kinds of wiring and look after motors; fine references. Address
L. K. W., care Electricity.

WANTED—Position by a young man, aged 20, with an electrical construction company; am a High School graduate and have had one year in electrical engineering at college; no practical experience; references as to character furnished. Address
H. R. W., care Electricity

WANTED—Position by Italian civil engineer and electrician, 30 years' old, with practice in telephony, telegraphy, railroad, mine, architecture; speaks, English, French, Italian and Spanish; Boston or vicinity preferred; best references. Address
H. M., care Electricity.

WANTED—Position by electrical and mechanical engineer; 4½ years university; 5 years' practice in designing electrical apparatus and motors combined with special machines. Address E. F. J., care Electricity

WANTED—Position as superintendent or general caretaker of some good electric light plant; 16 years' practical experience in the electric field; best of references; aged 36; married. Address J. A. P. care Electricity.

WANTED—Position as electrician by young man; 4 years' experience in light and power business; technical graduate in light and power; now taking engineering course; has good position; wants change. Address C. E. T., care Electricity.

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A

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THE AMERICAN NEWS COMPANY.

CONTENTS.

EDITORIAL NOTES.

Electric Traction in City Streets.

Elsewhere in this issue will be found a very interesting article from our London correspondent on the subject of surface contact traction in England.

As most every one interested in electrical matters is aware, during the past few years various municipalities in Great Britain have installed instead of the overhead trolley system some one of the numerous sub-surface contact systems that have been patented.

Some of these systems have been given a practical trial with fairly satisfactory results, according to the article from our correspondent. They do not appear to have been troubled by snow, as one would be led to believe they would be, but this can probably be accounted for by the fact that the winters in England are not nearly so severe as those in North America. The article informs us that in several cases the so-called "studs," have been left "alive" through various causes and that persons have actually stepped on them without even being made aware of the fact that they were charged with current. A dog and a sheep it seems, were the only victims of the live stud in one town, while though a few horses were brought down they were not hurt.

The conclusions reached by the author as to the advantages and economy of the contact system may be all right and satisfactory to our cousins across the Atlantic, but it seems to be the general consensus of opinion among electrical engineers and street railway men in the United States that the only way to build a conduit system is with iron yokes and a slot such as that in use in Manhattan Borough.

Such a system, it is true, costs a large amount of money to build, but when finished and in running order eliminates, as far as can be eliminated, all the dangerous elements of a street railway system in crowded city streets.

* * *

The Greatest of Modern Problems.

A Wall Street magnate was very much surprised when, in the course of a conversation with an electrical engineer, he was informed that the light of an incandescent lamp does not represent 1 per cent. of the energy of the coal consumed in producing it. "Why this is simply barbarous," he exclaimed, "only a little better than the torch of our primitive ancestors." When we review the complicated means employed to produce the little light we have and the enormous dissipation of energy which attends its production, the above remarks, in spite of our vaunted and extensive scientific knowledge, seem very apropos. Where does the trouble lie? Is it in the light-producing, or the power-producing methods at present in vogue? Is it in the electric light or the power station? These are fundamental questions which in a sense affect the future destiny of every electro-technical expert in the country.

The trouble lies in our crude method of oxidation. It has not been improved upon radically since fire was first used. The greatest of modern problems is that of oxidizing coal in such a manner that the waste of power attendant upon the transformation of its potential energy through combustion is successfully obviated. Our best electro-chemists have labored at this problem. Van T'Hoff, Arrhenius and Oswaldt as specialists and Helmholtz and Lord Kelvin in the field

of speculative and general science have mapped out the course of procedure.

The idea calls for the utilization of a medium through which coal can be oxidized without a rise of temperature and its energy successfully transformed into electricity. Instead of the triple process of transformation—the development of thermal energy, of dynamic energy and finally electrical energy—two of these processes will be cut out. The transformation will be direct and, from a theoretical standpoint, an immense economy will result which certainly should be approximated to some degree in actual practice.

The attempt to reach a greater efficiency in the lamp is but one phase of the problem, and various vacuum tube and mercury vapor systems testify to serious work in this direction. But the problem is manifestly one of cheaper power, and to attain this end radical changes must be instituted in our present methods, and the saving of power in the lamp but waives the problem.

* * *

Government Control of Wireless Telegraphy.

According to advices from Washington, D. C., the Navy Department has signed a contract with a wireless telegraph company for wireless service under Government control.

The Navy has felt keenly the necessity of a wireless connection between its naval bases at Guantanamo, Culebra and Key West, realizing that in the event of hostility with a foreign power the existing cable system would be the first point of attack. The necessity of protecting the canal zone has enlarged the problem of finding a secondary means for commnication, and the general board has learned a lesson from the isolation of Port Arthur in the present war. Therefore, some time ago, the equipment bureau began a series of competitive tests under the immediate direction of Lieut.-Commander Jayne, and the result was the arrangement between Admiral Manney and Mr. White to sign a contract for the supply to the Government of wireless instruments guaranteed to maintain trustworthy service on these circuits: Key West to Panama, 1,000 miles; Porto Rico to Key West, 1,000 miles; South Cuban coast to Panama, 720 miles; Pensacola to Key West, 450 miles, and South Cuba to Porto Rico, 600 miles.

The service proposed is exceptional, in that the wireless currents must traverse not only the ocean, but leap over islands, such as Cuba and Hayti, and in the latter case, and perhaps in others, run a risk of crossing currents set up by apparatus on islands not a part of the United States. The contracting company assumes full responsibility for the working of the system in such cases.

On its part, the Government agrees to operate in harmony with such stations and vessels as now use the De Forest system, and this is said to extend to Panama. The Government's instruments will be attuned to harmonize with those of the company to prevent interference. The Navy will have the company's key, so the two may work interchangeably without the possibility of their messages being picked up, or stolen, or suppressed by vessels or stations equipped with other kinds of apparatus. The enormous value of wireless telegraphy in naval operations, as revealed by Admiral Togo's last exploit off Port Arthur, hastened the action of the Navy Department in closing this contract.

It is also announced that the De Forest Company has begun the erection of a wireless station at Seattle, Wash., for the purpose of experimenting on the Pacific, and it is said that an attempt will shortly be made to communicate with Japan.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The University of Oxford, England, has conferred the honor of a degree of doctor of science on Mr. G. Marconi.

A dispatch from Colorado Springs, Col., says that Nikola Tesla has abandoned his wireless telegraph station which he established there in 1898. The instruments will be shipped to New York. The station stood at an altitude of seven thousand feet, facing Pike's Peak.

The Exposition Electricity Club, embracing all electricians connected with the St. Louis Exposition, has been formed with Frank H. Gale, of Schenectady, N. Y., as president.

The General Electric Company has received a contract for about $1,000,000 worth of supplies for the Ontario & Niagara Falls Power Company, which will operate 45,000 kw. of generating apparatus on the Canadian side of the Falls.

The manager of some works on the Baltic has received a message reporting progress in the repairs to one of the Russian ironclads from his company's branch establishment at Port Arthur, which is said to have been sent by wirless telegraphy via Chefoo. Although there is no evidence at present that the Russian authorities in the East have received messages by such means, says the *Electrical Engineer*, London, an interesting point of international law may arise out of the question of wireless communication. Some of the authorities who are examining the question are inclined to hold that if a blockaded port is in wireless communication with the shore station on neutral territory, this does not necessarily constitute a breach of neutrality on the part of the country in whose territory the receiving station is situated, any more than would communication over an unsevered cable, the contention being that the enemy has a remedy by stationing a vessel between the dispatching and receiving station fitted up with the necessary apparatus for interfering with wireless messages.

Improvements by the Brooklyn Rapid Transit Company to cost $10,000,000 are to be made, including fire-proofing its cars.

The next meeting of the Association of Edison Illuminating Companies will be held at Hotel Wentworth, New Castle, N. H., August 30 and 31 and September 1.

It has been decided that the subway of this city would be formally opened on September 1. Elaborate ceremonies will mark the beginning of the underground service, and a programme for the eventful day will be drawn by the city officials and the officers of the Interborough Rapid Transit Company.

The special commission named under a concurrent resolution of the Senate and Assembly at the last session of the Legislature to investigate the subject of electrical towing on the canals in this State, will meet in Albany in the office of the State Engineer, July 6 (to-day). Senator Lewis, of Rochester, is chairman of the commission. The State Canal Advisory Board will meet in Albany, July 6, 7 and 8, and the meeting of the special commission was called for the 6th in order that the members of the advisory board might be present. The commission on July 6 will organize and map out its work. The Legislature set aside $5,000 to cover the expenses of the investigation. The commission will hold public hearings and it is probable that experiments will be conducted this summer. A report on the investigation will be made to the Governor and Legislature in 1905.

SOME RECENT APPLICATIONS OF ELECTRICITY ON A SMALL SCALE.

BY HOWARD S. KNOWLTON.

The adaptability of electricity to all sorts of purposes is illustrated daily in the progress of the art. One of the latest applications is in the photographic dark room. For a long time the amateur photographer has been obliged to use greasy candles or ill-smelling and explosive oil lamps in his ruby or orange colored dark room lanterns, with the resulting vitiation of the atmosphere, sacrifice of cleanliness and risk of fire. High candle-powered incandescent lamps have given almost too much light for developing purposes, but recently a one-candle power lamp has been devised which fills the bill perfectly. The lamp is made to set into a small socket mounted on a brass standard about 8 inches high, and is placed in the focus of a reflector which throws the rays directly upon the developing pan. The lamp bulb is of either ruby or orange colored glass, as desired. The brass standard is mounted upon a small box which contains three open circuit cells, these cells supplying current to the lamp at about 4.5 volts. The battery may be run about one-half hour at a time without injury, and may be used 30 or 40 times before replacement. The three cells are fastened together in one solid body and may be replaced in a few seconds in case one desires to use the dark room for an hour or more. No adjustment of wires is necessary, contact with the lamp circuit being made automatically by two small brass springs attached to each battery. A small single point switch controls the lamp. The reflector is made to hold a screen of any desired color, in addition to the lamp bulb. The cost of the apparatus, with one battery of three cells, is about $3.50, and the price of additional batteries is 50 cents each. The cost of operation is thus about three cents per hour as against perhaps one cent for tallow candles, but the advantages of the electric lamp are so patent in point of comfort, convenience and safety, that a difference of two cents per hour is a small consideration, in view of the total cost of chemicals for developing, the cost of plates, films, and necessity of even temperature and absolute cleanliness if good work is to be done.

An interesting instance of the use of electricity in detecting tampering with telephone cash boxes occurred not long ago in Boston. A telephone box in one of the Back Bay hotels was robbed, and the company replaced the box by one which was electrically connected with the Back Bay Police Station, only a few hundred feet away. Two boys shortly afterward broke into the box again, causing a lamp to light in the police station. They were promptly captured at the telephone booth by the officers.

Electric candle lamps and cylindrical exploring lights have been on the market for some time, as have the greatest variety of delicate dental and surgical lamps. In going about closets, clothes presses, hallways and other rooms after dark, the advantages of these safe, cool and cleanly means of illumination are striking. The electric cigar lighter is also familiar, as is the small battery lamp of one or two candle power which so readily indicates the time of night when attached to a clock or watch and connected with a push button at the bedside. Still another application is the miner's flash-light with large lens and bell reflector, doing away with the danger of explosions and the discomfort of grease and oil.

Every user of Welsbach gas burners will welcome the advent of an electric lighting device, which ignites the gas on being held over the chimney, through the incandescence of a hot wire; this does away entirely with the dangerous use of matches and tapers. A similar apparatus for lighting gas stoves is now on the market, entirely eliminating the chance of burns or conflagrations in the use of this common domestic appliance.

The installation of electric bells in street cars for signaling motormen on the approach of stopping places has grown so rapidly in the past year or two that a car lacking the push button equipment may readily be said to be far behind the times. The convenience of this device to passengers can hardly be overestimated, and its simplicity justifies its addition to the already overburdened electric car.

In drying photographic plates the fan motor offers a means of greatly accelerating the process. This may often be done in twenty minutes or half an hour, by setting the plates in front of an ordinary 110 volt fan motor, whereas if natural drying were resorted to four or five hours would not be an uncommon requirement. Care must be taken in utilizing fan motors in this way, however, not to allow dust to accumulate upon the film of the plates as a result of the blowing process. Another use of the fan motor which became common in the past winter was the prevention of the frosting of windows. The powerful current of air from a fan motor causes all deposited moisture to evaporate so rapidly that the accumulation of frost is impossible.

The operation of sewing machines by means of small electric motors has been gathering in extent for several years past, and the elimination of physical wear and tear produced thereby is bound to constantly increase the favor with which mechanical driving is held by seamstresses. It is marvelous how readily electric driving can be applied to every sort of moving mechanism, from the printing press to the advertising toy which appears in the store windows, and it is interesting to think of the subdivisions which the energy of a great central station undergoes in distribution, whether it be in the lighting of an auditorium or the driving of a dental drill.

An ever widening field of application is found in the use of changeable and fixed electric signs of all kinds of shades and designs. The employment of colored lights in this connection opens the door to a veritable fairyland of scenic and striking effects which are easily possible with electricity. No other form of energy is safer or as flexible, if properly controlled. The triumphs of ingenuity shown in the illumination of the world's great expositions may be repeated in small scale advertising with the fullest measure of success.

A system of checking the work of watchmen in factories, mills, banks, public buildings, etc., is being applied to a considerable extent at this time. It involves few, if any, new principles of design, the improvement being in the line of its application. A series of numbered alarm boxes are placed in each establishment equipped and connected with a central office, usually the headquarters of one of the telegraph companies, where a man is constantly on duty during the night. As the watchman makes his rounds he "pulls in" each box at a specified time. In case the central office does not get regular signals from its customers supplied with the system, police assistance is quickly dispatched to the scene. Things cannot go wrong for more than a few minutes with this system of detection.

The "push button" engine stop is another device which is being extensively utilized of late. This apparatus stands between broken governor belts and the complete destruction of many an industrial power plant in cases where the attendants are unable to shut off steam or water quickly in sudden emergencies. Push buttons located at convenient points in the plant operate to start a small electric motor attached to the controlling valve which admits the steam or water supply in case of danger. The system may be made automatic if desired, so that

an engine or water wheel may instantly be shut down in case the speed exceeds the limit for which it has been set. Printing presses are also amenable to the action of a push button system of stopping, and cases are on record where life and limb have been saved through the quick stopping of machinery possible with the distributed system of controlling push buttons.

It is often the custom of men concerned with "heavy work" and large applications of electricity to scoff at these smaller uses of current, but the same laws are illustrated in the simple push button circuit as are found in the transmission of power over lines a hundred miles long, and a high order of skillful designing is equally essential for successful operation. Progress is constantly being made in the realm of small currents as well as in the domain of great powers, and the flexibility of applied electricity is as well exemplified in the telephone plant as in the multiple unit system of railway train control. The world is richer and civilization a step farther from the crudeness of aboriginal barbarism, for every new invention, small or large, which can be applied to the welfare of humanity, and the man who sneers at the smaller uses of electricity as of little account only betrays his own ignorance of the unsolved problems and limitless field which confront the worker in the so-called little things of the electrical art.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE VIII.

BY W. H. WAKEMAN.

Fig. 13 is a side view of Fig. 11 and is introduced for the purpose of showing

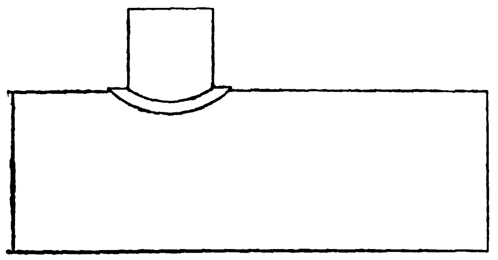


Fig. 13.

that when the manhole and steam nozzle are both located in the dome head, it is not necessary to cut other holes in the

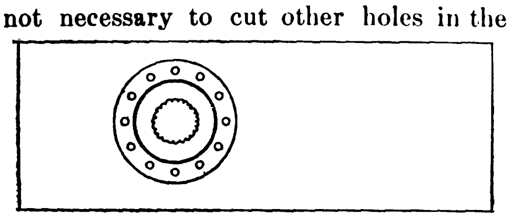


Fig. 14.

shell. Fig. 14 is a top view of the same boiler showing the ragged hole cut through the shell beneath the dome. When looking at a manhole left in this way, we are impressed with the idea that the boiler maker never intended to go through it many times, or else he would have taken off some of the sharp edges. This refers to holes on which there are no reinforcing rings. The idea of putting a manhole in the top of a dome, taken as a whole, is a bad one, not to be recommended, but it should be given all the credit due, as it certainly needs it.

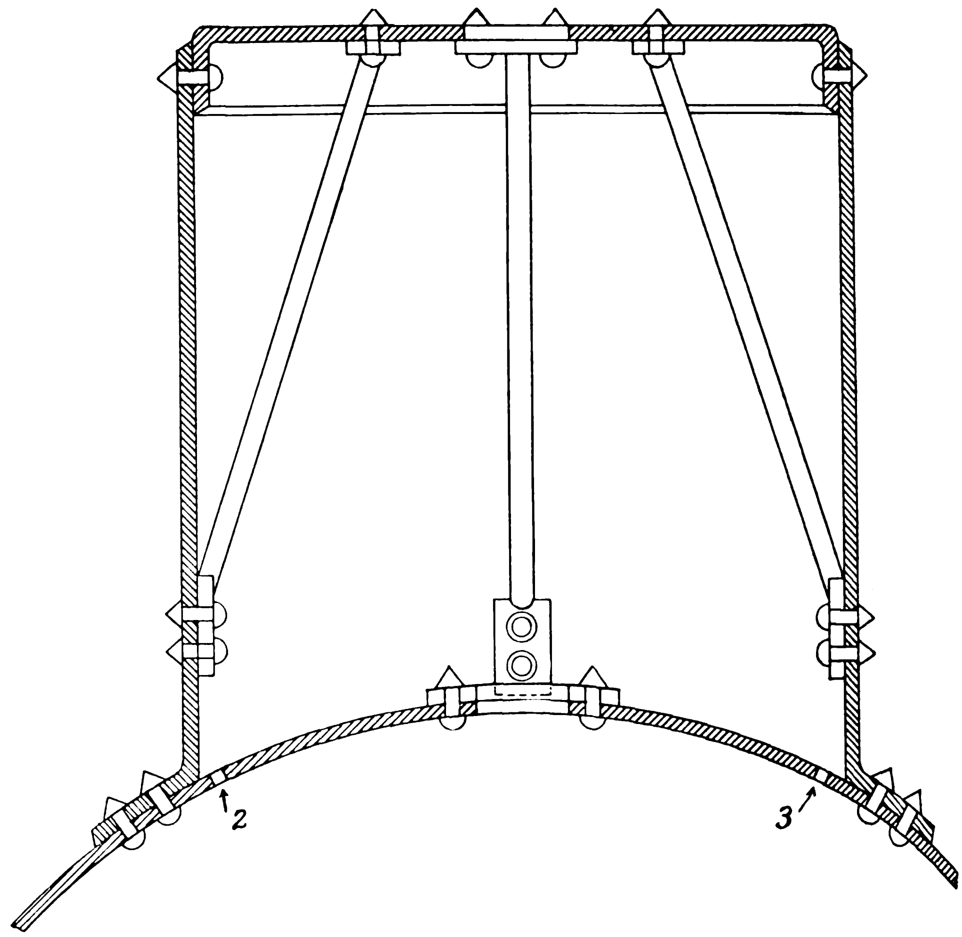


Fig. 15.

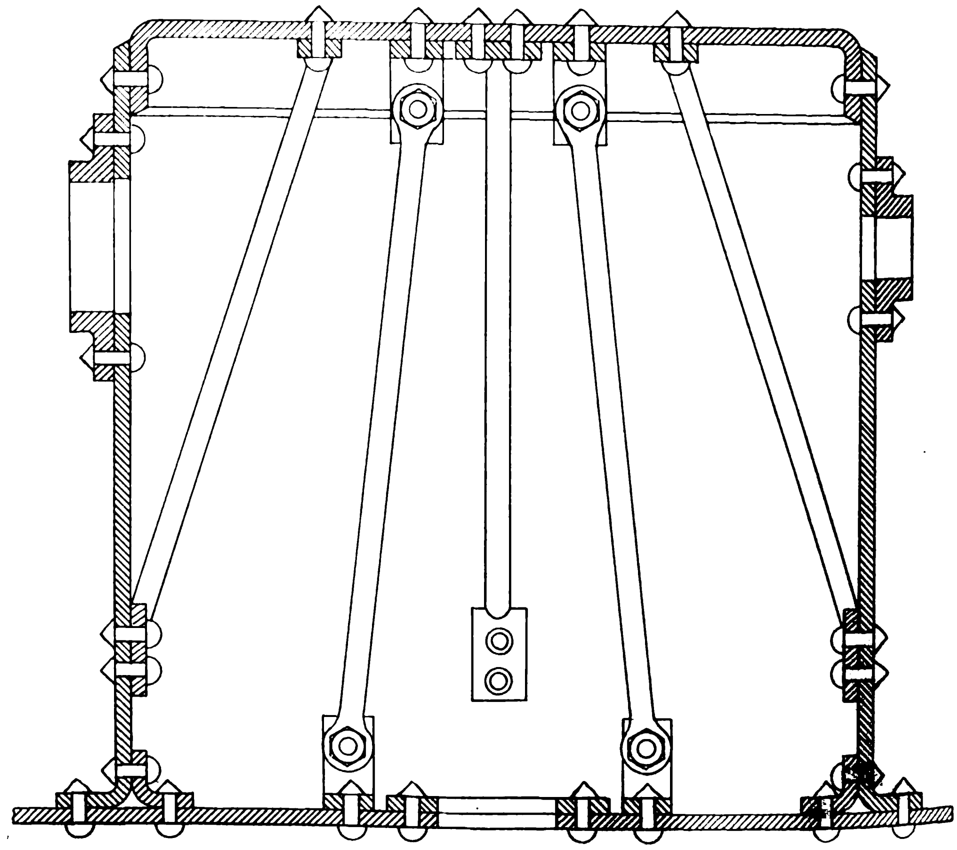


Fig. 16.

Fig. 15 illustrates a dome that is much stronger than Fig. 11, and is fastened to

the shell by a double row of rivets. It has a flat wrought iron head that is well braced, with only a hole for the steam nozzle in it. The same defect is shown here that was apparent in Fig. 12 as the passage from shell to dome is no larger than the steam outlet, hence the principle explained in the preceding article will cause wet steam to pass into the dome, and although some of the water passes back into the shell through holes at 2 and 3 this does not wholly eliminate the evil.

If additional braces were put in, extending from head of dome to shell below it, much strength would be added to the structure. As only a small hole is cut through the shell in Fig. 15 and a reinforcing ring is added, it is not weakened as much as when the plan shown in Fig. 14 is adopted, so far as the dome alone is concerned, but in that case it is necessary to cut another hole elsewhere in the shell for a man to enter, and this is a source of weakness which will receive further attention in due time. Holes for a dome and a separate manhole should never be cut in the same sheet, assuming that there is more than one in the upper half of shell.

Fig. 16 illustrates a well braced dome that does not materially weaken the shell to which it is attached. If all domes were made as strong as this, there would not be so much objection to them on general principles. Where it is fastened to the shell, a cover plate is added as a strengthening feature. There is also a reinforcing ring around the steam outlet.

Notwithstanding the good features found in this dome, it is defective in three respects. The braces cannot be readily inspected, as they can only be reached through the small steam outlet from inside of shell, and for the same reason it is difficult and expensive to repair them. Outlet from the shell is small, the great disadvantage of which has already been explained.

No special advantage is gained by placing steam nozzles on the side of dome as shown, except that it requires less height in which to locate a boiler with this arrangement. Flanges are riveted around these outlets which are threaded to receive the steam pipes. They also act as reinforcing rings. This kind of a dome is much more frequently found on marine than on land boilers, as greater strength is needed where a boiler does not remain stationary.

A number of Asheville, N. C., firms have dismantled their steam plants, installed motors and are now using electric power, which means a great deal for the cleanliness and healthfulness of that city.

REPORT OF THE COMMITTEE ON PROGRESS.*

BY T. COMMERFORD MARTIN.

(*Continued from page 360, Vol. 26.*)

ELECTRIC HEATING.

In a quiet and steady way, electric heating has advanced during the past year. Central station men do not realize yet their opportunities in this field. It is hardly an exaggeration to say that a great many of them look upon electric heating as experimental or chimerical, whereas nothing could be further from the truth, even allowing that present apparatus is likely to undergo great improvement in the course of the next few years. Of course, a great many stations to-day can not tell for what purpose their current is used, because they meter it, but it is certainly worthy of note that only 31 stations in 1902 in their returns to the Census Office reported the specific sale of current for electric heating. A great many others are doubtless in the business, but, when all is said, the street-railway field remains still the great examplar of electric heating. During the past severe winter every car on the whole Manhattan Elevated system of New York was heated electrically, representing at some hours of the day probably not less than 1,200 cars. In 1902, more than half of the street-railway cars in the United States were heated and of the number no fewer than 19,021, or 63 per cent., were heated by electricity. In other words, during the past winter, for months together, and almost down to the month of May, considerably over 20,000 cars have used current for heating several hours daily. In the aggregate this represents an enormous amount of service and current consumption; and yet it might be easily duplicated on central station circuits. Eighteen years ago, I ventured to suggest to doubting members of this association at Detroit, that there was money in the then infant motor or power service. No one questions that now.

One of the important electrical events of the year has been the equipment of the Government Printing Office in Washington—the largest printing establishment in the world—with the largest electric-heating plant in the world; to say nothing of the fact that there are over 600 power motors in use under the one roof. Mr. W. H. Tapley, the progressive electrical engineer of the office, with the courage of his convictions has spent a large sum to great advantage on a plant that is really an extraordinary exemplification of the flexibility and economy of electric heating. The work is characterized by a great deal of originality and thoroughness, for which the staff, in conjunction with Mr. W. S. Hadaway, Jr., must be ascribed great credit. The use of electric heat in the office fall broadly into two groups or classes. One of these embraces the foundry and includes matrix-drying tables, wax-stripping tables, wax-melting kettles, case-warming cabinets, "builders-up" tool heaters, case-warming table, wax-knife cutting-down machine, "sweating-on" machine, and soldering-iron heaters. The other class in the bindery includes embossing and stamping press heads, glue-heater equipments, glue cookers, case-making machines, finishers' tool heaters and book-cover shaping machines. This is a remarkable range, but in addition and outside these we find the pamphlet-covering machines, the sealing-wax melters and some other devices. It is only when one sees such an equipment as has been devised for and brought together in the Government Printing Office that one grasps fully the idea of the extraordinary range and utility of electric heating. Such heating may not yet take care of a big building, but in such special applications as these it cannot be surpassed or equalled for efficiency and economy.

The equipment of these electrically heated appliances in the office supplants gas and steam in all processes. Practically all the apparatus was made from new designs by Mr. Hadaway with careful attention to mechanical details, and with large factors of safety electrically. The specifications of the controlling appliances were rigid, and necessitated new switch designs giving great strength and durability. The switches are mounted upon slate slabs and protected by iron covers, all connections being soldered to lugs. The slabs are mounted upon iron or slate bases so that every precaution may be taken against accident. In cases where working temperatures are moderate, the apparatus is operated on 117 volts. Where high temperatures and rapid rates of impartivity are required, lower variable voltages are used. These are secured by translating appliances consisting of rotary converters and transformers with several taps on secondaries. The extreme ranges of energy density in various appliances are from 0.75 watt to 40 watts per square inch superficial area. The plant gives great satisfaction, and is already being imitated in other large printing offices, notably that now being equipped by the New York *Times*, which will employ a

*Abstract of report read before the National Electric Light Association at its 27th Convention, held at Boston, Mass., May 24-27, 1904.

great deal of electric heat, depending upon current furnished from the street mains of the New York Edison Company.

Another exemplification of the growing scale upon which electric heating is used, is furnished by the Berg hat factory, of Orange Valley, New Jersey, with a capacity of 300 dozen felt hats per day. There approximately 100 kilowatts, or half the entire average output of the plant, is used up in the electrically heated devices for making the hats.

Our able past-president, Mr. James I. Ayer, who is devoting his ability and energy to the subject, showed me recently a photograph of over two tons of electric-heating apparatus he was shipping abroad on foreign orders, followed shortly after by another shipment equally large. Mr. Ayer notes this year, as last, the revelation of the fact that heating is going on unknown to central-station managers, by the fact that complaints are made when circuits have been shut down for overhauling in the daytime. This has been true, for example, at Somerville, Mass., and Newton, Mass. Mr. Ayer notes in general an increase of orders and inquiries both from central stations and from factories.

One incident reported to me by Mr. Ayer of the advantage of electric heat over other methods was conspicuously developed at Harvard Memorial Hall, which is the dining-room of many students of Harvard University (about 1,500 regularly take their meals there), by the introduction of electric waffle irons, displacing gas irons. Electric waffle irons, being heated on both sides at once, produce a more perfect product and do the work more quickly than with gas. In the regular operation of baking waffles batter is poured into half of a mould, the other half being closed over it, and in the case of gas the heat is applied on one side for a period. Then the mould is turned over and the heat applied to the other side. With electricity, the heat being supplied on both sides by having each half of the mould directly heated, this turning is avoided.

To prevent the waffle sticking to the iron, it is necessary to apply oil or lard. In the case of a gas iron, much of this oil gets on the outside of the iron and is converted into smoke by the flame. In the case of electric irons, no such loss occurs, and no such smoke develops. On account of irregular heating, it is frequently necessary to open the mould of the gas iron to test the progress of the baking. In the case of electric irons, this is totally unnecessary, as the time element is definite, and the moulds are not opened until the prescribed time has elapsed.

It was found that for serving the students, where there was demand for about 250 waffles in one hour, one operator with the electric irons could do the work of two with gas; the smoke nuisance was eliminated, the saving in oil was considerably more than half that required for gas, and subsequently, recent improvements in electric waffle irons have resulted in the elimination of the use of oil entirely. Another curious thing is that it takes about 20 per cent. less batter with the electric iron for the same number of waffles that was required with the gas. The reason appears to be that the cooking is done much more quickly; hence a lighter article is produced.

(To be continued.)

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(Continued from page 355, Vol. 26.)

The Wiring Table.—The manufacture of wire for electric light and power purposes has meant the utilization of a variety of wire gauges; among which, the most important is the Brown and Sharpe, commonly indicated as the B. &. S. gauge. These gauges differ from each other in their sizes and the circular mils corresponding to these sizes If the B. & S. gauge is taken as the standard, all the sizes of wire in this particular gauge can be shown to arbitrarily arise from a consideration of the No. 10 size. This has approximately 10,400 circular mils cross section and a resistance of about 1 ohm per 1,000 feet.

An examination of the B. & S. table will show the following interesting facts, of which practical use may be made in the development of a table for ready reference that will be almost identical with the wire manufacturers. In the first place, every three sizes of wire mean that the circular mils have either doubled or halved. For instance, a No. 10 wire, B. & S., has 10,380 circular mils; if a No. 7, which is three sizes larger, is compared, it is found to possess twice as many circular mils or 20,760. On the other hand, compaing a No. 13 wire, which is three sizes smaller, only one-half the circular mils, or 5,190, are found. The same process can be carried on with respect to No. 10 B. & S., for every size given in the regular wire table, such as Nos. 13, 16, 19, 22, etc., as well as Nos. 7, 4, 1,000, etc.

It is well to know that the numbers corresponding to the different sizes of wire do not correspond numerically to the circular mils they represent. The circular mils of a wire diminish according to the table as the number of the wire increases. A No. 0 wire has more circular mils than a No. 10; or a No. 13 wire has less circular mils than a No. 10, etc. These facts are best understood by a careful survey of the wire table as printed by the well-known manufacturers:

Gauge No. B. & S.	Diameter in inches.	Cross section. Circular mils.
4—0	0.4600	211,600
3—0	0.4096	167,800
2—0	0.3648	133,100
1—0	0.3249	105,500
1	0.2893	83,690
2	0.2576	66,370
3	0.2294	52,630
4	0.2043	41,740
5	0.1819	33,100
6	0.1620	26,250
7	0.1443	20,820
8	0.1285	16,510
9	0.1144	13,090
10	0.1019	10,380

The above figures give all sizes of wire as indicated from No. 10 B. & S. to No. 4—0, in other words, all of the larger sizes. According to the empirical rule just given No. 7 wire must have twice the circular mils of No. 10; No. 4 twice the circular mils of No. 7, etc., as shown below:

No. 10..10,380 C. M., according to table.
" 7..twice No.10 B & S, or 20,760 C.M.
" 4.. " " 7 " " 41,520 "
" 1.. " " 4 " " 83,040 "
" 3—0. " " 1 " "166,080 "

The intermediate sizes, such as the sizes that lie between No. 10 and No. 7, No. 7 and No. 4, etc., are found as follows: The difference in circular mils between No. 10 and No. 7 is 10,380; these are divided up equally between the three sizes, namely, Nos. 9, 8 and No. 7 gauge. Dividing this difference into three parts gives $10{,}380 \div 3 = 3{,}460$ circular mils. If 3,460 circular mils are added to No. 10, No. 9 is obtained as shown below:

No. 10 = 10,380 cir. mils = 10,380
" 9 = 10,380 + 3,460 = 13,840
" 8 = 10,380 + (2 × 3,460) = 17,300
" 7 = 10,380 + (3 × 3,460) = 20,760

This process must be followed out in arriving at the size of wire if the circular mils are given, or if a table is to be developed for practical purposes. The circular mils obtained by this method are such that they will show clearly the size required. A comparison of the circular mils of the manufacturers' table and the above circular mils will demonstrate this fact.

Regular wire table.	Calculated sizes.	Difference.
No. 10..10,380	No. 10..10,380	0
" 9..13,090	" 9..13,840	750
" 8..16,510	" 8..17,300	790
" 7..20,820	" 7..20,760	60

In spite of apparently large differences in area as shown by Nos. 9 and 8, between the regular table and the calculated sizes, the nearest sizes manufactured to those calculated are Nos. 9 and 8 of the regular table. This removes any doubt of the practicability of the method. The other half of the table giving the sizes from No.10 to No.16, which are the lesser sizes, is subject to exactly the same rules:

Gauge No. B. & S.	Diameter in inches.	Cross section in circular mils.
10	0.1019	10,380
11	0.09074	8,324
12	0.08081	6,530
13	0.07196	5,178
14	0.06408	4,107
15	0.05707	3,257
16	0.05082	2,583

A point of difference arises, however, when size No. 13 is to be obtained from No. 10; in other words, when passing from a larger to a smaller size of wire. In this case the difference is to be subtracted instead of added. This means the recollection of the following rule:

Rule:—In passing from smaller to larger sizes of wire add the difference; in passing from larger to smaller sizes of wire subtract the difference.

To illustrate this fact, No. 10 wire differs from No. 13 wire as 10,380 circular mils differ from 5,190 circular mils. This means that each intermediate size from No. 10 to No. 13 varies one-third of 5,190 circular mils or 1,730 circular mils from its neighbor as indicated below:

Size wire.	Circular mils.	
10	10,380	= 10,380
11	10,380−($\frac{1}{3}$ × 5,190) =	8,650
12	10,380−($\frac{2}{3}$ × 5,190) =	6,920
13	10,380−($\frac{3}{3}$ × 5,190) =	5,190

Although the size and circular mils are obtained very readily by a little practice with the above method, it is very important to know how to get the resistances as well. This is not any more difficult than the preceding, assuming a resistance of 1 ohm per 1,000 feet of No. 10 wire. As the resistance of a wire is inversely proportional to its cross-section in circular mils, a No. 13 wire which has 5,190 circular mils or one-half as much cross section as a No. 10 would have twice the resistance per 1,000 feet or 2 ohms. A table can be constructed based on this principle as follows:

Ratio of C. M.	Size of wire.	Circular mils.	Resistance in ohms.
1	10	10,380	1.0000
2	7	20,760	.5000
4	4	41,520	.2500
8	1	83,040	.1250
16	3–0	166,080	.0625

The intermediate resistances are obtained by the same rule as that giving the circular mils. For instance, the resistance of a No. 9 and 8 is obtained by subtracting one-third of one-half of the difference in passing from the smaller sizes to the larger, and in adding one-third of one-half the difference in passing from the larger sizes to the smaller.

If No. 10 has 1 ohm per 1,000 feet, then No. 7 has .5 ohm per 1,000 feet and the difference is .5 ohm. This difference is divided by 3, giving .1666 ohm. In other words, the subtraction of .1666 ohm from No. 10 will give No. 9; subtracting .1666 ohm from No. 9 will give No. 8, etc., as indicated below:

Size wire.	Resistance per 1,000 feet.	
10	1	=1.0000
9	1−.1666	= .8334
8	1−(2 × .1666) =	.6668
7	1−(3 × .1666) =	.5000

For sizes which run the other way, that is, from a larger to a smaller size, in which case addition is necessary, the following figures are correct in passing from No. 10 to No. 13:

Size wire.	Resistance per 1,000 feet.	
10	1.0000	= 1.0000
11	1 + ($\frac{1}{3}$ × 1)	= 1.3333
12	1 + ($\frac{2}{3}$ × 1)	= 1.6666
13	1 + ($\frac{3}{3}$ × 1)	= 2.0000

By carefully following the method as described, entire independence of the regular wire table results. It is possible to arrive at the size, circular mils and resistance of any wire by a short calculation or a mental estimate, which not only saves time, but is an immense advantage to those employing such principles as given as a means of daily livelihood. A few examples will show the application and value of the process in a simple wiring system:

Example.—What is the size and circular mils of the wire required to conduct 30 amperes over a 350 foot run at a drop of 2 per cent., the pressure being 110 volts?

The data is as follows:

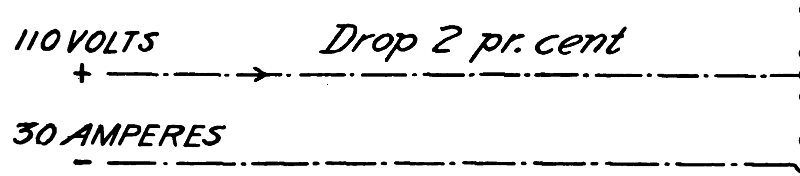
Drop................ 2.2 volts.
Length of wire....... 700 feet.
Amperes............. 30

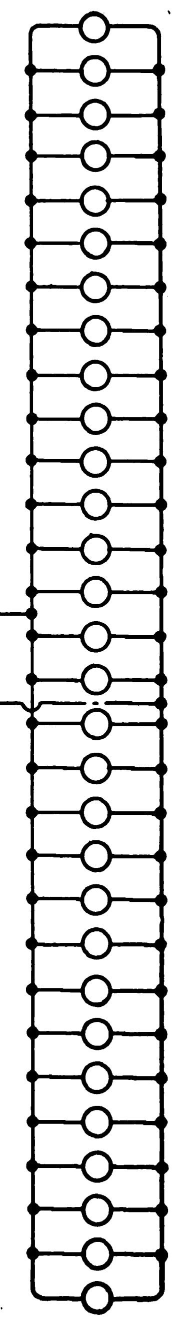
According to the formula:

$$\text{C. M.} = \frac{700 \times 30 \times 11}{2.2} = 105{,}000.$$

The practical question arising is this, what is the resistance per 1,000 feet and size corresponding to the answer? This is the method, starting from No. 10 B. & S:

No. 10..	10,380	1	ohm per 1,000 ft.
" 7..	20,760	.5	" " "
" 4..	41,520	.250	" " "
" 1..	83,040	.125	" " "
" 3–0..	166,080	.0625	" " "



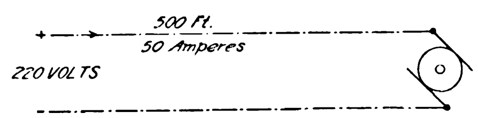


Estimating Circular Mils and Size of Wire Without Wire Table for Reference.

It is evidently between No. 1 and 3—0, and if one-third of the difference is added, or 27,680 circular mils, 110,720 are obtained corresponding to a No. 0 wire. The resistance of this size is .125 ohm minus one-third of the difference in resistance between the two sizes. The resistance of 1,000 feet of No. 0 wire is therefore approximately .1042 ohm. If 1,000 feet = .1042 ohm, then 700 feet = .073 ohm.

Applying the law that $E = C \times R$ to check the answer, the drop is found to be 30 amperes × .073 ohm = 2.19 volts.

In the above, the nearest size manufactured is No. 0, and this size would have to be employed even though a difference of 5,000 circular mils existed.



Calculating Power Line to Motor.

Example.— A power line is being run a distance of 500 feet to a 220 volt motor, taking 50 amperes with a drop of 5 per cent., what is the size of wire, etc.?

$$C.\ M. = \frac{1{,}000 \times 50 \times 11}{11} = 50{,}000.$$

No. 4 = 41,520.
No. 3 = 55,360.

The nearest size is No. 3 B. & S. and the resistance is approximately .209 ohm per 1,000 feet. The drop is therefore .209 × 50 = 9.45 volts, a little short, but still to the advantage of the contractor. A table may be prepared which will save a great deal of time if properly used, in which the drop in volts per ampere per 1,000 feet is given as follows:

Size wire.	Drop in volts per 1,000 ft. per amp.
10	1.0000
7	.5000
4	.2500
1	.1250
3—0	.0625

Taking it the other way toward the smaller sizes the figures are in near approximation.

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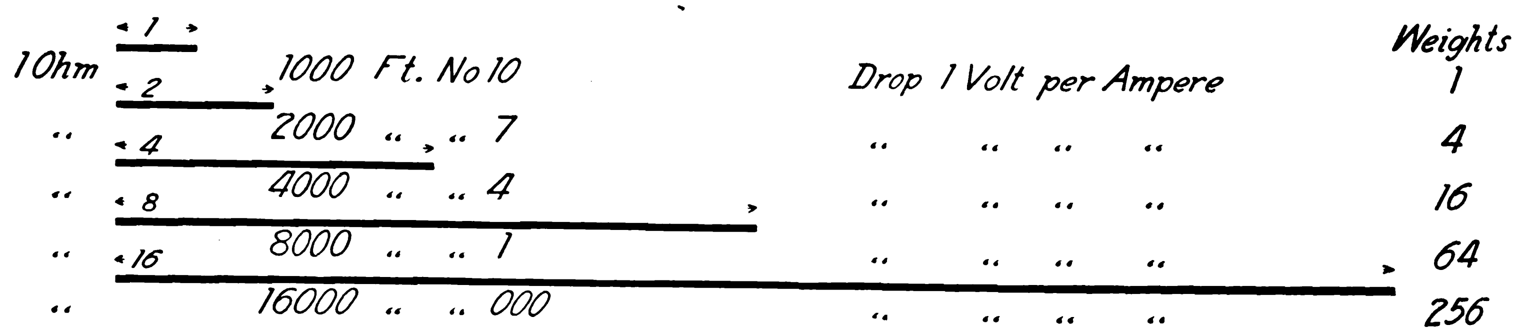
Size wire in B. & S. gauge.	Volts drop per 1,000 ft. per ampere.
4—0	.0523
3—0	.0625
2—0	.0833
1—0	.1041
1	.1250
2	.1666
3	.2082
4	.2500
5	.3333
6	.4166
7	.5000
8	.6666
9	.8333
10	1.0000
11	1.3333
12	1.6666
13	2.0000
14	2.6666



Relative Lengths and Weights of Wire of Equal Resistance.

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Distance 500 ft. Watts = 10,000, drop 5 per cent.

Size.	Volts.	Amperes.	Circular mils.	Relati weig of coppe
4—0	100	100	211,600	32
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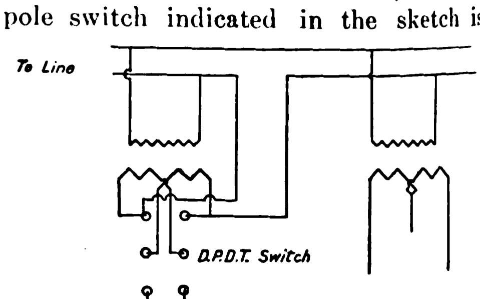

Booster of Double Range

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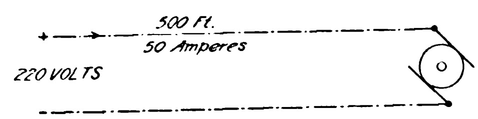
It is evidently between No. 1 and 3—0, and if one-third of the difference is added, or 27,680 circular mils, 110,720 are obtained corresponding to a No. 0 wire. The resistance of this size is .125 ohm minus one-third of the difference in resistance between the two sizes. The resistance of 1,000 feet of No. 0 wire is therefore approximately .1042 ohm. If 1,000 feet = .1042 ohm, then 700 feet = .073 ohm.

Applying the law that E = C × R to check the answer, the drop is found to be 30 amperes × .073 ohm = 2.19 volts.

In the above, the nearest size manufactured is No. 0, and this size would have to be employed even though a difference of 5,000 circular mils existed.



CALCULATING POWER LINE TO MOTOR.

Example.—A power line is being run a distance of 500 feet to a 220 volt motor, taking 50 amperes with a drop of 5 per cent., what is the size of wire, etc.?

$$C.\ M. = \frac{1,000 \times 50 \times 11}{11} = 50,000.$$

No. 4 = 41,520.
No. 3 = 55,360.

The nearest size is No. 3 B. & S. and the resistance is approximately .209 ohm per 1,000 feet. The drop is therefore .209 × 50 = 9.45 volts, a little short, but still to the advantage of the contractor. A table may be prepared which will save a great deal of time if properly used, in which the drop in volts per ampere per 1,000 feet is given as follows:

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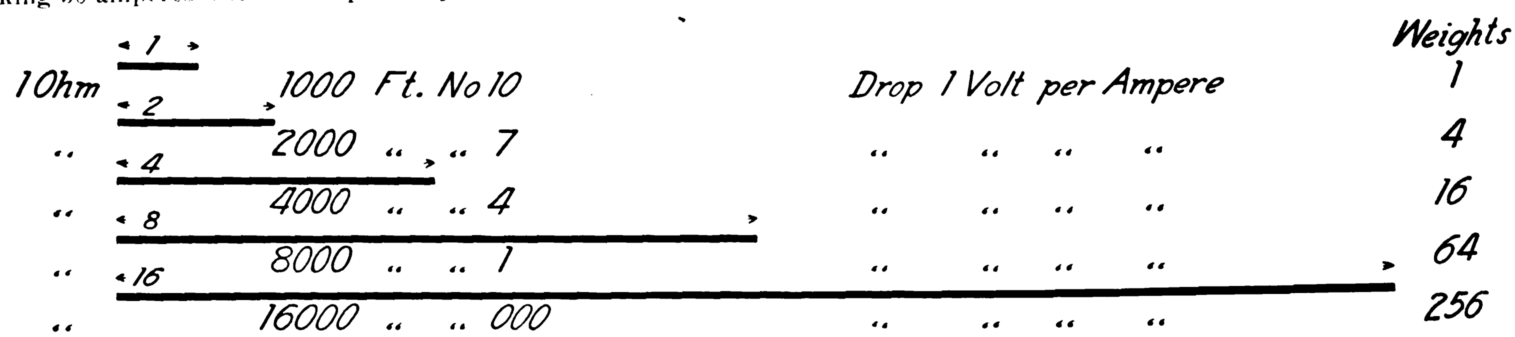

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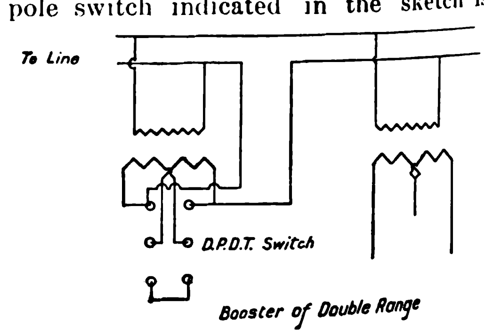

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sion, through the contact-making mechanism of the cup, without the latter receiving any appreciable damage. It is believed that this change will greatly reduce the number of defective boxes.

Defective boxes due to "shorts" are more frequent in summer than in winter, for light pieces of iron or steel are more easily picked up by the magnet when the track is dry and dusty than when it is covered with wet and sticky mud.

Wolverhampton has only had one experience of serious results attending shock from "live" studs, and that was six months ago when a sheep and dog were electrocuted through treading on a defective box. Horses are declared (as the result of actual experiments made by Mr. Shawfield at Wolverhampton) to be much less sensitive to a shock sustained by stepping on a charged metallic substance than to a shock received from a live conductor falling upon them from above. And this is in spite of the fact that they are shod with metal shoes. Horses have been brought down, but have suffered no other ill-effects. Mr. Shawfield goes so far as to say that he has on more than one occasion "watched a pedestrian step on a box which he (Mr. S.) has known to be 'alive' at a pressure of 500 volts, as recorded by a Weston voltmeter, but in all cases the indvidual was apparently quite unaware of the fact." The comparative harmlessness of such a shock is due to the high resistance of the vulcabeston cup, and to the fact that there is never under any conditions of breakdown or defect any metallic connection between the top-plate and the supply main.

In regard to the question of reliability of operation, 146 car miles were lost, due to defects in the electrical equipment of both cars and track, averaging 3¼ miles out of every 10,000 car miles run, but frequent and heavy snow falls were experienced during the year, and allowing for that fact, Mr. Shawfield is of the opinion that this constitutes "a record of regularity of service which it is difficult to surpass."

One of the most serious disadvantages of the surface contact system is the increased consumption of electrical energy which it involves. The additional quantity required varies according to the type of surface contact system adopted, but with practically every type of system there are three causes which must involve additional current consumption. They are: (1) Energy required to operate the circuit closing mechanism of the track equipment. (2) Additional energy necessary for the propulsion of the cars owing to the extra weight of the special apparatus carried on the car. (3) The surface leakage from box to rail over the paving under each car on the track.

The tendency is for the current consumption to be rather heavy (1.49 units per car mile) owing to severe gradients, muddy and greasy track in wet weather, and correspondingly dusty in dry.

We need not follow Mr. Shawfield into his other points, but may state his main conclusions thus: (1) A well-designed and carefully installed surface contact system is superior to the overhead trolley system in respect of the questions of safety, reliability, disfigurement of streets and obstruction to traffic. (2) The overhead system is considerably cheaper both as regards the capital cost of installation, and the annual cost of operation and maintenance. (3) For tramway systems where low initial cost and low annual charges are the first consideration, and especially for light railways in thinly populated districts, the overhead system is to be preferred. (4) In many larger towns, and especially in watering places and other pleasure resorts, the surface contact system has many claims for serious consideration in preference to the overhead trolley system.

Carbon Brushes on Dynamos.

BY J. W. BURLEIGH.

It is surprising that the carbon brush is still used on dynamos, in spite of the increased knowledge of dynamo design. This practically necessitates large commutators and extra expense of brush gear, large shafts and longer machines, and therefore, must increase the cost of production by a large amount. Especially is this the case where large currents have to be dealt with. This practice results from the designer's doubt of the efficacy of metal brushes. Carbon brushes not only increase the first cost, but lower the efficiency, so that it frequently happens that this might be increased 2 or 3 per cent. by the use of metal brushes. Consulting engineers demand carbon brushes, unmindful of the fact that so long as sparkless commutation is secured it is immaterial of what the brush be made. Comparing the design of a commutator for a six-pole 88-kilowatt parallel-wound armature for carbon and for metal brushes it is found that the use of carbon necessitates three times as many brushes as the metal. For the former the commutator must be 17 inches long, and for the latter only 6. The watts lost, due to the friction of the carbon brush, number 1,025, as against 205 for metal. The watts lost, due to the resistance of contact of the former, are 1,260, as against 434, making the total loss 2,285 watts for carbon and 639 for metal. The watts lost per square inch are 2.51 for carbon and 2 for metal. The commercial efficiency with the carbon brush is 91.8 per cent.; with metal, 93.4 per cent. The chief virtue of the carbon brush is its high specific resistance, which facilitates sparkless commutation. To secure a similar condition with metal brushes they may be subdivided with an insulating partition between the portions; or the central layers of metal may have a higher specific resistance. Where a reversible motor is employed a radial brush is necessary, but it would not be impossible to construct a satisfactory brush of this type out of metal.—*Abstract from the Electrical Review, London.*

The International Electrical Congress.

The latest bulletins sent out in regard to the International Electrical Congress are as follows:

It is expected that the opening session of the Congress and the sessions of the sections will be held in the Coliseum Building, situated in the heart of the city of St. Louis, and therefore in close proximity to the hotels at which members will be quartered. The final session of the Congress may be held within the Exposition confines on Saturday, September 17.

In response to invitation, the following foreign Governments have appointed delegates: Switzerland, Prof. Ferdinand Weber, Prof. Francois Louis Schule; Norway and Sweden, Prof. G. Arrhenius; India, Mr. J. C. Shields; Mexico, Mr. Rafael R. Arizpe.

The delegates of the National Electric Light Association and their papers to the Congress are as follows: Mr. George Eastman, Section E, "Protection and Control of Large High-Tension Distributing Systems;" Mr. G. Ross Green, Section E, "American Meter Practice;" Dr. F. A C. Perrine, Section D, "American Practice in High-Tension Line Construction and Operation."

The delegates of the American Institute of Electrical Engineers and their papers to the Congress are as follows: Mr. Ralph D. Mershon, Section D, "The Maximum Distance to which Power Can Be Economically Transmitted;" Prof. M. I. Pupin, Section A, "Electrical Impulses and Multiple Oscillators;" Prof. C.P. Steinmetz, Section D, "The Theory of the Single-Phase Motor."

The delegates of the Electrochemical Society and their papers to the Congress are as follows: Prof, W. D. Bancroft,

Section C, "The Chemistry of Electroplating;" Prof. H. S. Carhart (with Dr. G. A. Hulett), Section C, "The Preparation of Materials for Standard Cells and their Construction;" Prof. L. Kahlenberg, Section C, "The Electrochemical Series of the Metals."

The delegates of the Association of Edison Illuminating Companies and their papers to the Congress are as follows: Mr. W. C. L. Eglin, Section E, "Rotary Converters and Motor-Generators in Connection with the Transformation of High-Tension Alternating Current to Low-Tension Direct Current;" Mr. L. A. Ferguson, Section E, "Underground Electrical Construction;" Mr. Gerhard Goettling, Section E, "Storage Batteries as an Adjunct to Station Equipment."

Transit Merger Rumored Again.

Wall Street is again full of reports and gossip that an agreement had been made to merge the subway system, owned by the Interborough Company, and the elevated railroad lines in Manhattan, leased by the same company, with the lines included in the group known as the Metropolitan system of surface lines. There was no furthur basis for the reports than have existed for many months, which is the logical conclusion that ultimately all the transit companies in the city will be merged.

Recently there have been conferences looking toward a combination, or, at least, some working agreement, but the conferences so far have considered the question only tenatively. Ultimately, it is expected, some agreement will be reached, but no agreement has been closed.

Old and New Methods of Railway Transportation.

The railway exhibits at the St. Louis World's Fair have been collected and prepared with a view not only of showing present methods, but also of comparing them with past methods of development in this and other countries.

The visitor sees the first locomotive that was constructed, as well as the latest and more perfect specimens of the builders' art; there are models of English and American freight yards, showing how commerce is distributed at great railway terminals and delivered to connecting lines solely by the power of gravitation.

And no less amazing is the progress of the electric railway, which is clearly illustrated from the slow horse car to the third-rail system with a demonstrated speed capacity of 130 miles an hour.

Marconi Stockholder Sues.

Henry Gardner, a stockholder in the Marconi Wireless Telegraph Company of America, has begun an action in the Supreme Court in this city against the corporation and its directors for an accounting of the company's assets and the appointment of a receiver. He charges extravagance and mismanagement.

John Bottomley, secretary and treasurer of the Marconi Wireless Telegraph Company, and W. H. Bentley, a director of the company, make vigorous denial of the charges contained in the suit brought by Mr. Gardner.

Mr. Bottomley asserts that the company does not owe a debt of more than one hundred dollars on open account and that there is a large surplus in bank, while its aggregate debts are of a small amount for current accounts. Mr. Bottomley branded as untrue the allegation that salaries to the amount of $85,000 are paid out, declaring that the actual sum is less than one-sixth as much.

The whole proceeding, says Mr. Bottomley, is instigated by a rival of the company to affect the sale of Marconi stock.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 28, 1904.

Electric Railways and Appliances.

763,364. Third Rail for Electric Railways. Jacob Caesar, New York City. Filed March 2, 1903.

763,390. Electric Railway-Switch. Edward A. Gray and Silas H. Brand, Chicago, Ill. Filed Feb. 11, 1904.

763,411. Automatic Electric Block-Signal. William A. Luby, Kalamazoo. Mich. Filed June 25, 1903.

763,420. Automatic Signaling System for Railways. William N. Owen, Conway, Ark. Filed Oct. 7, 1903.

763,434. Insulating-Support for Electric Third Rails. Frederick R. Slater, New York City, assignor to Robert W. Lyle, same place. Filed May 28, 1903.

763,435. Contact Device for Under-Contact Third Rails. Frederick R. Slater, New York City, assignor of one-third to Robert W. Lyle, same place. Filed June 20, 1903.

763,509. Trolley Guard and Finder. William F. Reichenbach, Rochester, N. Y. Filed Oct. 15, 1903.

763,515. Train-Operated Time-Signal System for Railways. William B. Severance, Auburn, N. H. Filed Nov. 10, 1902.

763,766. Signaling Means for Railroads. Horatio A. Johnson, St. Paul. Minn. Filed Nov. 9, 1903.

763,820. Trolley-pole. Andrus S. Weaver, Joy, N. Y. Filed Aug. 19, 1903.

763,921. Electrically-Controlled Automatic Block System for Operating Railway-Signals. Alfred Oesterreicher, Vienna, Austria-Hungary, assignor of one-half to Lorenz Nemelka, same place. Filed Oct. 4, 1902.

763,939. Automatic Train Signaling and Recording System. Frank R. Wood and Daniel F. Shamberger, Sparrows Point, Md. Filed Aug. 24 1903

Electric Lights and Appliances

763 495. Electric-Lighting System for Vehicles. John A. Little, St. Louis, Mo., assignor to the Globe Electric Company, same place. Filed Oct. 3, 1903.

Electrical Machinery and Apparatus.

763,355. Electric-Fixture Support for Outlet-Boxes. William F. Bossert, Utica, N. Y., assignor to the Bossert Electric Constfuction Company Filed Jan. 9, 1904.

763,379. Alternating-Current Induction-Motor. George B. Dusinberre, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company Filed Dec. 29, 1902. Renewed Aug. 8, 1903.

763,464. Circuit-Closing Device. Albert B. Chance, Centralia, Mo. Filed April 6, 1903.

763,477. Transmission-Gear. Frank G. Gies, Detroit, Mich. Filed Dec. 18, 1902.

763,501. Electric Transmitter. Arthur J. Mundy, Boston, and Albert E. Smith, Waltham, Mass., assignors to the Submarine Signal Company, Waterville, Me. Filed Sept. 8, 1903.

763,510. Magneto-Electric Generator. Benjamin P. Remy and Frank I. Remy, Anderson, Ind. Filed March 14, 1903.

763,520. Electric Switch. Walter S. Tobie, Augusta, Ill. Filed Feb. 10, 1904.

763,547. Alternating-Current Induction-Motor. George B. Dusinberre, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 27, 1904.

763,658. Control of Dynamo-Electric Machinery. Eugene R. Carichoff, East Orange, N. J., assignor to the Sprague Electric Company. Filed Aug. 1, 1901.

763,774. Alternating-Current Motor. Mitford C. Massie, Washington, D. C., assignor of one-half to Max Georgi, same place. Filed Feb. 12, 1904.

763,812. Resistance for Electrical Uses. James F. Tracy, Sheridanville, Pa., assignor of one-half to William H. McFadden, Pittsburg, Pa. Filed Dec. 12, 1903.

763,845. Means for Securing the Stators and Rotors of Electrical Machines in Adjustable Relation. Hans Bohmlander and Rudolf Pfeifer, Charlottenburg, Germany. Filed Feb. 24, 1902.

Telephones and Telephone Apparatus

763,351. Selective Signaling System. Garrison Babcock, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed May 18,

763,374. Telephone System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed March 2, 1903.

763,404. Switchboard Apparatus. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Jan. 13, 1903.

763,412. Automatic Electrical Exchange. Frank A. Lundquist, John Frickson and Charles J. Erickson, Chicago, Ill., assignors, by direct and mesne assignments, to themselves, John Anderson, Salina, Kan., and the Globe Automatic Telephone Company, Chicago, Ill, Filed Dec. 2, 1893.

763,755. Combined Telephone Receiver and Transmitter. Johan G. Holmstrom, Stockholm, Sweden, assignor to the Elektromilitara Aktiebolaget, same place. Filed Aug. 14, 1903.

763,803. Signaling System for Telephone-Exchanges. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company. Filed Oct. 26, 1901.

763,911. Call-Register for Telephone Systems. Jacob W. Lattig, West Bethlehem, and Charles L. Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, Westchester, Pa. Filed June 6, 1903.

763,940. Telephone-Directory. Myron G. Brownell, Denver, Col. Filed April 9, 1904.

Miscellaneous.

763 350. Lightning-Arrester. Garrison Babcock, Chicago, Ill. Filed Sept. 20, 1902. Renewed April 18, 1904.
1903.

763,358. Electric Coke-Oven. Michael R. Conley, New York City. Filed Sept. 8, 1903.

763,479. Process of Electrolytic Manufacture of Aluminum. Gustave Gin, Paris, France. Filed May 14, 1903.

763,516 Apparatus for Demonstrating the Efficiency of Lightning-Rods. Harvey Simpson, Burlington, Wis. Filed Feb. 29, 1904.

763 565. Secondary Battery. Jacob W. Madigin, Toronto. Canada. Filed Jan. 10, 1903.

763,657. Electrical Apparatus for Therapeutical Purposes. John P. Brown, Rogers, Ark. Filed April 20, 1904.

763,674. Electric Battery. Pierre J. Kamperdyk, New York City. Filed Oct. 14, 1903.

763,772. Apparatus for Wireless Telegraphy. Guglielmo Marconi, London, Eng., assignor to the Marconi's Wireless Telegraph Company, Limited, same place. Filed Nov. 10, 1900.

763,893. Wireless Telegraphy. William S. Hogg, Washington, D. C., assignor of one-half to the Greater New York Security Company, New York City, Filed Sept. 22, 1902.

763,908. Submarine Telegraphy. Isidor Kitsee, Philadelphia, Pa. Filed Oct. 28, 1899. Renewed Dec. 22, 1903.

THE TELEPHONE WORLD.

Better Service but Higher Rates for Duluth.

The Zenith Telephone Company, of Duluth. Minn., has increased its rentals for business telephones, where there is only one party on the line, to $36 per year. The increase is made under authority of the franchise granted the company at the city election in February. The price of party lines will be $30 a year.

In advising patrons of the increased price the company calls attention to the improved service. in which connections are given in from one-half a second to five seconds after the receiver is taken down, with less than three seconds for answering calls.

It is stated that the quality of the service has improved 100 per cent. since the old rates were established. About $75,000 is to be invested in further improvements and in correcting defects as they are discovered. Patrons, it is claimed, are entitled to unlimited conversations with nearly 4,000 subscribers in Duluth and Superior.

A. M. Taylor, of Penn Yan, lately explained before the New York State Independent Telephone Association at Buffalo how his company gained the patronage of farmers by keeping a blackboard in each exchange, upon which a list of cattle, live stock, hay, chickens and similar truck for sale and wanted was posted. Whenever a farmer wanted a shoat, all he had to do was to call up central and be connected with the man who had shoats for sale. If there was none on the list, his name and number was chalked down until there was activity in the shoat market.

A novel telephone system is in successful operation between Wausaukee, Wis., and some of its neighboring towns, the top strand of a barbed wire fence along the right of way of the Milwaukee road being used. About 70 telephones have been installed in homes of farmers, and other patrons are being secured.

The Columbus, Ga., Telephone Company has leased more room, and is enlarging its quarters considerably. Since the company has been in operation in Columbus it has made rapid strides. It now has in the neighborhood of 1,000 subscribers and the addition of space is to make room for more selector boards so that a much greater number can be accommodated.

Dubuque and East Dubuque, Ia., will be joined together before long with another telephone line. When the line is established in East Dubuque, extensions will be made to Galena and other Eastern cities. It is planned to get into Chicago. The company has made a large number of extensions to towns in Wisconsin and is constantly branching out.

The new telephone company of Lincoln, Neb., is receiving new material daily for the construction of its new system in that city.

Business men of Booneville, Miss., have organized a telephone company, and been granted a franchise to construct an Independent system.

The Lawrence, Kan., city council has granted a telephone franchise to an Independent company.

Independent Companies Effect Organization in Ohio.

The Miami Valley Telephone Association was organized at Piqua last month. The organization is made up of the representatives of the Independent telephone companies in the counties of Montgomery, Miami, Darke, Shelby, Campaign, Clark and Logan. A committee was appointed to nominate officers and report at a meeting to be held in the near future. The committee is made up of W. D. Rush, of Greenville; Louis Simes, Covington; H. P. Miller, Dayton; A. J. Hess, Sidney, and A. F. Broomhall, Troy.

General Manager M. B. Oberley, of Cleveland, of the United States Telephone Company, which controls the long-distance line in Ohio and the adjacent States, was present at the meeting, as was J. S. Brailey, of Toledo, representing the Central Construction Company.

These gentlemen assured the telephone men present that it is the intention of their companies to push the work of constructing new lines in that part of the State vigorously, and that in the near future lines will be in operation enabling the local exchanges to afford through service to points in Illinois, Indiana and the West. The first large city to be reached by the proposed extensions will be Kansas City, and the others will follow as rapidly as possible.

The wire is now on the ground, and work will be begun at once on a full copper line from Piqua to Lima, and when this is finished it will give Piqua direct Independent connection with Toledo.

New lines will also be started at once from Greenville to Dayton, and between Piqua and Covington, by the local company, while the United States people will construct a cable from Dayton to Richmond, which will bring a number of towns into direct connection with the companies in that part of the State.

The growth of the Independent telephone business in Ohio has been very rapid. The movement only took shape in 1900, and to-day in Miami County alone there are over 4,100 Independent 'phones in use located as follows: Piqua, 1,500; Troy, 1,400; Covington, 400; Pleasant Hill, 200; West Milton, 600. Other counties report a similar growth.

Plans have been filed with Superintendent Hopper for the enlargement of the main offices and exchange of the New York Telephone Company at Nos. 13 and 17 Dey street by the erection of a new 15-story fireproof addition, 51 feet front, and 89½ feet deep, to be built on adjoining lots at Nos. 9 and 11 Dey street. The exchange at No. 14 Cortlandt street is also to be enlarged.

The People's Rural Telephone Company has begun the setting of poles from Swedesboro to Mullica Hill, N. J. Poles are on the ground for 10 miles ahead of the workmen. It will require 3,000 poles for the proposed route.

A telephone company has been formed to build a line from Toluca, in Stafford County, Va., by Garrisonville and Stafford Court House, to Brooke by Boscobel to Fredericksburg.

Telephone System Between Port Arthur and Duluth

Business men from Port Arthur, Ont., have visited the towns bordering on the north shore of Lake Superior for the purpose of establishing a telephone system between Port Arthur and Duluth, Minn. The line will be 196 miles long. The company will be incorporated under the laws of Minnesota.

This is an enterprise that has been in the minds of north shore residents for a long time. It was carefully investigated a few years ago, but nothing resulted. Since then, however, the country has been settling up and the business interests have increased rapidly and are now extensive enough to justify renewed interest in the matter. It is said the promoters have met with much encouragement from business interests and that the project would be a certainty.

Telephone Lines Completed.

The Gainesboro Long Distance Telephone Company, of Carrollton, Ga., announces the completion of its extension from Cedartown, Ga., to Bordentown Springs, Ala., a line 18 miles in length connecting this popular and frequented watering place with the outside world. The telephone company has also completed a double circuit on the Atlanta and Jackson, Ga., branch of its system, which was a part of the acquisition when that company bought out and took over the Commercial Telephone Company of Atlanta, a few months ago.

The Central District & Printing Telegraph Company has opened a new exchange at Carrick, Pa., on the suburban trolley line some distance south of Mt. Oliver The new exchange is considered part of the Pittsburg city district; is to be known as Carrick, and covers a territory of about 4 square miles heretofore entirely without telephone connection. Sixty telephones are installed and the number will soon be increased to 80.

Meetings of the board of directors of the Hudson River Telephone Company are now held quarterly in Albany, N. Y., instead of monthly, as heretofore, while the meetings of the executive committee of the board are held in New York City.

The Farmers' Independent Telephone Company, of Waushara County, Wis., Emil Pocket, president, and E. J. Hoeft, secretary, has filed an amendment increasing the capital stock from $1,000 to $2,500.

For telephone service, in the coming fiscal year, Buffalo, N. Y., will spend $5,269.67.

The Automatic Telephone Company has asked the Old Town, Me., city council for a franchise.

Telephone Incorporations.

The Urbana Independent Telephone Company, Urbana, Ind. Capital stock, $10,000. Directors: Emanuel Stover, Adam Cook, George Pretorious, E. F. Baker and J. C. Schmolzried.

The Egyptian Mutual Telephone Company, Temple Hill, Ill. Capital stock, $2,500. Incorporators: William G. Holmes, H. M. Stokes and John Mann.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alpena, Mich.—This city will sell electric light bonds of $100,000.

Auburn, N. Y.—The Auburn Light, Heat & Power Company contemplates improving its plant and will erect a new boiler house, also install a 400 hp. boiler and rebuild the engine room.

Baker City, Ore.—This city will soon be supplied with electric light and power from the Rock Creek power plant, some 20 miles northwest of here.

Brookville, Pa.—A new electric lighting plant is being talked of here.

Clinton, La.—The Clinton electric light and ice plant was lately sold at sheriff's sale to Isidor Mazen. A new company will be organized of all home people. The plant is now in operation and will no doubt be a success in the future.

Coatesville, Pa.—The Coatesville Consumers' Electric Light, Heat & Power Company has been incorporated with a capital of $15,000.

Coldwater, O.—R. C. Stueve, of Wapakoneta, has secured a 10-year franchise to erect and operate an electric light plant in this place.

Gibson City, Ill.—The Gibson Electric Light & Power Company of this city has been incorporated with a capital of $30,000, by L. J. Hiland and S. J. Lefevere.

Greenville, Me.—Hon. F. E. Guernsey has organized the Greenville Electric Light & Power Company here. The capital stock is $10,000.

Hawarden, Ia.—The city electric light plant needs rebuilding at a cost of about $5,000.

Harrington, Wash.—H. W. Fellows, an electric engineer of Spokane, has been here recently looking over the town with a view of establishing a plant. He met with encouragement and promises to return soon with the intention of locating.

Healdsburg, Cal.—Preparations are being made to establish an electric light plant and power system here.

Hillsboro, Ill.—The board of supervisors has granted the privilege to the Hillsboro Electric Light & Power Company to erect and maintain electric light wires over the highways of Montgomery County.

Ithaca, Mich.—This village is to be bonded for $13,000 for the building and equipment of an electric light plant.

Lebanon, Ind.—This city is considering an electric light proposition.

Macon, La.—This city has voted $12,000 to buy the electric lighting plant here, and improve it.

Macon, Miss.—A $12,000 bond issue for the erection of an electric lighting plant was carried at the recent election. The city will operate the new light plant in connection with the waterworks plant.

Newberry, Mich.—The council is considering the advisability of abolishing the flat rate charged the patrons of the electric light plant and putting the whole town on a meter rate, the town furnishing its patrons with meters. It is argued that this arrangement will prove much more equitable and fair to all concerned, each patron thereby paying for exactly the amount of current consumed.

Ocean Springs, Miss.—An electric light plant will soon be established here.

Sandusky, O.—An ordinance granting the right to C. B. Dewitt to construct, maintain and operate an electric lighting, heating and power plant has been passed.

San Luis Potosi, Mex.—Senator Marshall Hicks, Dr. Paschal W. Schuwirt and others, of San Antonio, Tex., are desirous of establishing an electric light plant here.

Saybrook, Ill.—Electric lights will soon be put in here.

Sioux Rapids, Ia.—The people here are talking of investing $6,000 in a new electric light plant.

St. Ignace, Mich.—The electric light and waterworks plant here was lately destroyed by fire, with a loss of about $20,000. A new model plant will be built at once.

STREET RAILWAYS.

Adamstown, Pa.—A charter has been granted to the Adamstown & Mohnsville Electric Railway Company. The road will be 8 miles long, and will be the connecting link between Lancaster and Reading. The expectation is that the road will be in operation in 90 days, when electric cars will be run from Lancaster to Reading.

Allegan, Mich.—The promoters of the Grand Rapids & South Haven electric line have applied for a franchise to operate the road through this place. The road will have a branch from the main line here, the branch running to Otsego.

Chicago, Ill.—Pending action by the city council on the proposition to allow the use of electricity as motive power on the Evanston branch of the Chicago, Milwaukee & St. Paul Railway, a tentative agreement for such a deal is now in the hands of officials of that corporation and of the Northwestern Elevated Company. Terms have practically been agreed upon and it is understood that Clarence Buckingham will finance the deal in New York City.

Cleburne, Tex.—Dallas capitalists are endeavoring to get a franchise from this city to build a street car line here. They first wanted a bonus, but when they saw that the citizens here had given about $500,000 to get railroads to come, and that the sentiment was not any too strong on offering a bonus to a street railway proposition, they decided to put the proposition on a stock basis and ask for no bonus.

Hanover, Pa.—The York Traction Company will erect a large addition to its present Hanover power plant.

Janesville, Wis.—P. W. Ryan, of this city, has the contract to build an electric line in Mineral Point.

Metuchen, N. J.—Harry C. Van Emburgh, of Plainfield, has finished the preliminary survey for the map to show the route proposed for the trolley line from here to Plainfield. The line has been run along the highway from the Marconnier Chapel, Plainfield, to the Metuchen line.

Mineola, N. Y.—The Mineola, Port Washington & Roslyn Traction Company has received a franchise from the Nassau County board of supervisors to run a trolley line from here to Port Washington and Roslyn where it will connect with another trolley extending out on Long Island. Frederick Parker, brother of Justice Parker, is secretary.

Nashville, Tenn.—R. D. Fitzgerald, of Rochester, N. Y., representing a party of New York capitalists, has been here looking over the field in regard to building an electric line between this city and Chattanooga.

Pittsburg, Pa.—Local politicians are securing charters for a large number of traction lines through the western part of the State, as far east as Johnstown and Punxsutawney, and as far north as Kittanning.

Salem, Ore.—The building of an electric line to connect this city and Portland is strongly indicated by negotiations which are pending for the purchase of right-of-way between these two places.

St. Joseph, Mo.—The St. Joseph Interurban Railway Company, which plans to build to Stanberry; the St. Joseph, Parkville & Kansas City Railway Company, which will build to Kansas City by way of Parkville, and the Maryville & St. Joseph Electric Railway Company, which has Maryville and this city as its objective points, are interurban projects now being pushed through the preliminary stages, and the indications are that two and possibly all three of them will be in course of construction before snow flies.

Thomaston, Conn.—The Bristol Tramway Company is surveying the road for an electric line.

POWER PLANTS.

Grand Ledge, Mich.—The Grand Ledge Electric Power Company, organized with $50,000 capital, to build and acquire water power and supply electric power at and near this city, has been incorporated by E. C. Jarvis, of Lansing, who holds 200 of the 250 shares of the company. The other stockholders are Joseph H. Bootes and Glen D. Smith, of Jackson. The company proposes to utilize the water in Grand River for generating electric power and will either acquire the water privileges here or build a dam near this city.

Rockwood, Col.—It is announced that the company projecting the great electric power enterprise here has let contracts for buildings, dam and flume, aggregating $65,000. This enterprise includes furnishing electric power for the entire San Juan County.

BIDS WANTED.

Glenville, O.—Sealed proposals will be received by the secretary of the board of public service, M. W. Miles, until July 20, for lighting the streets with electric lights.

Toledo, O.—Sealed proposals will be received by the board of trustees of the Massillon State Hospital until July 9, for the erection of a power house, also for one 450 hp. engine, two 350 hp. boilers, one 300 kw. generator, and one switchboard. Address H. C. Hyman, M. D., secretary of the hospital board.

Williamsport, Pa.—Sealed proposals will be received by the light and water committee of this city, until July 29, for electrically lighting the streets of this city. Address A. F. Young, chairman of the light and water committee.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12⅝c.; Lake 12⅝@12¾c.; casting, 12⅛@12¼c.

New Jersey Traction, at 68½, is in demand, in Philadelphia.

The General Electric Company has applied to the New York Stock Exchange to list $4,317,300 additional capital stock.

A dividend of 1½ per cent. will be paid on the stock of the Consolidated Traction Company of New Jersey on July 15.

Attorney Luke O'Reilly says he is bringing damage suits at the rate of about 50 a day against the Brooklyn Rapid Transit Company.

It is said that control of the stock of the New York & Long Island Telephone Company has passed to the New York & New Jersey Telephone Company.

The Rochester Railway Company has been granted authority by the New York State Railroad Commission to increase its capital stock from $5,000,000 to $5,500,000.

The stockholders of the Baltimore & Belair Electric Railway Company have authorized the issue of $500,000, thirty-year, 5 per cent. gold bonds with the International Trust Company of Maryland as trustee.

A report has gained currency that the American Telephone & Telegraph Company and the Postal Telegraph Company are working together in the joint use of toll lines in the South and West, which is considered indicative of the close relationship between these two companies.

The Cincinnati Gas & Electric Company has sent out notice to stockholders that $1,740,004 of treasury stock would be floated to pay for that amount of improvements made the past year or to be completed this summer. The stock is offered at par and is part of the $2,000,000 issue authorized a year ago.

Negotiations between the city of Chicago and the Union Traction Company for a renewal of franchises have been finally and definitely broken off. As rapidly as franchises on individual lines expire, the company will be ordered to remove its tracks and surrender possession of the streets of Chicago to the city.

About $3,100,000 of 5 per cent. bonds of the Boston & Northern and Old Colony Street Railway Companies are now callable and can be refunded into 4 per cent. bonds, an annual saving of $31,000 in interest. This refunding will not be done at once, but is a matter which will probably receive attention in the not distant future.

The Potomac Electric Power Company of Washington, D. C., placed on record a mortgage, pledging all its property, rights, and franchises to secure the Commercial Trust Company, of New Jersey, in the payment of $4,000,000 in 25 years. The loan will be represented by 4,000 gold bonds of $1,000 each, bearing 5 per cent. interest.

Another story about Brooklyn Rapid Transit is current, to the effect that a large block of the company's 4 per cent. bonds had been sold. This story met with denial in semi-official quarters, but the denial was of such a technical nature as to convey the impression that a sale of bonds had been negotiated. Street gossip placed the amount of Brooklyn Rapid Transit bonds sold at from five to ten million dollars, at a rumored price of 75, and that the syndicate which took them was marketing the bonds around 77. It is not surprising that these sales, if any were made, were quietly accomplished, for the reason that those interested in the company are desirous of making an active market for the $5,000,000 listed some time ago

ELEOTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Noon price July 5
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	149⅞
Metropolitan Street Railway	115⅛
Metropolitan Securities	84
Ninth Avenue	195
Third Avenue	118¾
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	49⅛
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	65¼
Philadelphia Traction	96¼
Union Traction, $17.50 paid	50
Boston.	
Boston Elevated, full paid	141
West End Street, com	91
do. do. do. pref	111
Chicago.	
City Railway	175
North Chicago	71
Union Traction, com	5½
do. do. pref	29½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	32
do. do. pref	66
Electric Lead Reduction	⅝
Electric Vehicle, com	9
do. do. pref	12
Westinghouse, com	156
do. pref	190
General Electric	157
Boston.	
Edison Electric Illuminating	235
General Electric	157
Massachusetts Electric Companies, com	19½
do. do. do. pref	73
Westinghouse Electric & Mfg., com	79
do. do. do. pref	98
Chicago.	
Chicago Edison	142
National Carbon, com	28
do. do. pref	101⅛
Philadelphia.	
Electric Company of America	8
Electric Storage Battery, com	55
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	131¼
Western Telephone Company	7
New England Telephone Company	121½
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	187
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	87
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

Electricity in Japanese Warfare.

The world is naturally astounded at the remarkable success of the Japanese in the war with Russia. To all the European powers Japan was merely a name for an island race of artistic tastes, gentle manners and a semi-barbaric civilization. But the revelations that have come to their startled eyes show underneath the artistic tendencies, peaceable demeanor and oriental splendor, the practicability, aggressiveness and thorough knowledge of modern science that places Japan on a par with the so-called mightier powers, whose vaunted civilization and progressiveness have been accepted as representing the fruit of generations of academic learning.

It is said that thirty years ago the Japanese were no better advanced than the Chinese. If that is the case to what can we attribute this remarkable transformation. Is there in the Japanese spirit the same love of science that is known as one of the greatest characteristics of the German people? Is Japan discovering within herself latent powers which have recently exhibited themselves as adaptability in the handling of modern machinery and inventiveness in the field of electricity and high explosives?

The Japanese have shown thorough familiarity with the use of electricity in naval and military warfare. It has been stated on good authority that their wireless telegraphic apparatus is an improvement on existing types and their electrical engineers are men of thorough training and remarkable skill, ready for any emergency that may arise in mortal combat.

The great battleships and armored cruisers are in a sense electrically controlled, and the torpedo boats are among the first in the complexity of their electrical equipments. Perhaps it may be said that naval warfare particularly is becoming, in the light of hosts of modern electrical improvements, electrical warfare, and for that reason alone the destiny of Japan is not only in the hands of her admirals and generals but her electrical engineers.

* * *

The International Electrical Congress.

Elsewhere in this issue will be found an abstract of a circular of information which should prove of value to foreign electrical engineers about to visit this country with a view to participating in the International Electrical Congress to be held at St. Louis,

The Congress is held under the auspices of the Louisiana Purchase Exposition and will contain Government delegates, while seven American electrical bodies and several foreign societies of the same character are co-operating.

The interest in this Congress, which is the lineal successor to that of Paris in 1900, may be gathered from the fact that already nearly 1,800 applications have been received and 150 papers promised from some of the most celebrated electricians and physicists. Of this number a large proportion are Europeans, and the vanguard from the other side is expected to arrive the last week in August, when a body of about 150 strong is to land in Boston, recruited entirely from the British Institution of Electrical Engineers. About the same time a party of about 100 from Italy will land in New York, and from here the whole party, including many others arriving about that time, will leave immediately after Labor Day for St. Louis by special trains. The party will not go directly to the Congress, but will visit Schenectady, Montreal, Niagara

Falls, Buffalo and Chicago. The great electric lighting, street railway and power transmission enterprises at these cities will be inspected and the delegates will be entertained by the respective managements. After a week of Congress work in St. Louis, from September 11 to 18, the visitors will go to Pittsburg over the Pennsylvania Railroad, and thence to Washington and Philadelphia, and while at Washington will assist officially in the dedication of the recently erected office and laboratories of the United States Bureau of Standards, at which time President Roosevelt will participate. On the return to New York at the end of September the party will break up and proceed homeward at will; but a trip is planned to some of the interesting points in this vicinity, including the Edison Laboratories.

It is several years since foreign electrical engineers have visited this country in this manner, and, in fact, one has to go back to the Chicago Electrical Congress of 1893 for an antecedent occasion of this character. A great deal of interest is being taken in the affair by American electrical engineers, and the various electrical companies are contributing liberally to the entertainment fund, $5,000 being contributed in New York alone It is proposed, however, in this way to recognize and return the official and private hospitality extended in England and France in 1900 as well as in other countries since that time.

* * *

An Electrical Divining Rod. Some time ago there appeared in ELECTRICITY an article describing an ingenious apparatus which had been brought out in England for detecting the presence of minerals in the ground by means of an electric current. This perfected device was recently exhibited in London by one of the inventors, and its working was explained by Prof. Silvanus Thompson.

As long ago as 1854, a well-known English inventor, Mr. James B. Lindsay, patented a device for sending electric signals through the ground; but it was Sir William Preece's discovery, in his study of the flow of electric impulses through the earth, that the shape and density of the electric field are affected by the geological formation of the underlying strata, which gave the idea of the electrical ore detector recently shown. It is claimed—and the claim is supported by the results of what appear to be very satisfactory experiments—that metalliferous deposits, invisible to the prospector and often undiscoverable by the mining engineer, can be located, traced and mapped out. Transmitting inductors deliver electric waves which are extremely sensitive to the presence of minerals, and receiving resonators are tuned to detect these waves and determine their character. When the field to be explored has been energized, the operator goes over the ground, and receives manifestations of the waves beneath. As a mineral vein or lode is approached, the waves change in intensity or direction, or both, and when the lode is reached the variation and intensity are most marked. Indeed, the changes that take place in the sounds conveyed to the ear are so well defined that the expert listener can tell much in regard to the depth and width of the ore deposit. Professor Thompson expressed satisfaction that the inventors do not claim that the apparatus will find every kind of ore; but from his own investigations he could assert that for a large number of metalliferous mines which are good conductors the instrument will be of the greatest use.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The General Electric Company is credited in some quarters with a desire to take over the Allis-Chalmers Company. It is asserted that negotiations are already under way for the purchase. The Allis-Chalmers Company is capitalized at $36,000,000 with no bonded debt. It is not paying any dividends. On the present market prices of its preferred and common stocks the company has a market value of $8,800,000.

Mr. T. B. Behr, of London, Eng., inventor of the electrical monorail railroad, a line of which is being constructed between Manchester and Liverpool, is in St. Louis where a working model of his car is being exhibited at the World's Fair by the British Government.

The Wolverine coal mines in Bay City, Mich., will be equipped with a miniature underground electric road. The plan is to place trolleys upon the coal cars within the mines, thus doing away entirely with mule service. The claim is made that one car operated by electricity can do the work of eight hauled by mules. There are at present 23 mules in the mines.

A man by the name of McVey of Glasgow, Scotland, has patented a ladder and platform to be used in trimming arc lamps. The ladder is automatically locked to the post while the lamp is being trimmed, and cannot be blown down or off the post. It is also locked to the post by another spring almost at the foot of the ladder. The ladder is 5 feet 10 inches from the ground, and carts or cabs cannot therefore come in contact with it, insuring safety to the trimmer. The patentee claims that this dispenses with the services of a trimmer's assistant, as his work under the old system is mainly to watch the traffic and see that the ladder is not interfered with.

As a result of a recent consideration of the question by officers of the United States Signal Corps the War Department will purchase two "auto" telegraph and repair wagons for experimentel use during the military manœuvres near Manassas in September next. It is also intended to use a signal corps balloon train at Manassas as well as during the manœuvres on the Pacific Coast. The corps will also install field telegraph and 'phone systems, and there will be a practical trial of the wireless.

A powerful battleship searchlight has been put in operation in Upper Geyser basin at the Yellowstone Park to show the working of the geyser at night. The effect, it is said, is marvelously beautiful, and hereafter the searchlight illuminations of the active geysers will be a feature in the National Park.

Though the automobile is still in its infancy, says the *St. James' Gazette*, it has a long and variegated history behind it. Its progress towards the perfection which still remains to be attained has been somewhat spasmodic. Its origin we owe to France, and there can be no question as to Cugnot's claim to recognition as the "father of the motor-car." The Cugnot steam carriage of 1769, though its inventor's ideas were years ahead of the mechanical means available in his day, was a very rudimentary affair, defective in construction and bad to steer. It is on record, however, that it developed sufficient pace and power to carry away the fencing which inclosed the trial ground where it made its first appearance. Owing perhaps to this somewhat discouraging debut, as well as to the difficulties which beset the pioneer of a new field of mechanical invention, the Cugnot car ended the matter, so far as France was concerned, for some time. We still await the silent, odorless machine.

WIRING LEAFLETS.

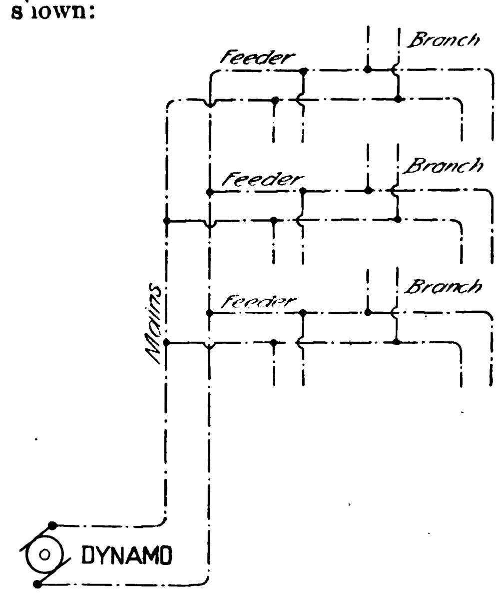
BY NEWTON HARRISON, E. E.

(*Continued from page 8.*)

Elements of a Wiring System.—The analysis of a wiring system discloses three fundamental elements, called mains, feeders and branches. These parts are subject to the same calculation for the discovery of the drop taking place in them as any simple circuit previously described. In laying out a wiring system these elements must be carefully considered and a great deal of discretion is necessary in making allowance for the distribution of the total drop in each part. If, for instance, the total drop is 10 volts, and this is to be divided up between the elements above mentioned, the average drop in mains, feeders, and branches would be 3.333 volts. But there is no fixed rule for this conclusion and the drop in the elements of a wiring system must be left largely to the judgment and experience of the contractor. To the contractor such questions arise in connection with this fact as: What is the cost of copper? What is the cost of labor? The labor question is by far the most important one, because it would be easy to show by comparing the cost of materials included under the head of mains, feeders and branches as well as the moulding or tubing in which they would be laid with the cost of labor in installing them, that labor is of the first importance. One hundred dollars worth of materials may cost anywhere from $50 to $200 or more to install. It would be difficult indeed to attempt to give iron-clad rules for determining these relationships, but perhaps the best that can be done is to follow the common-sense rule of laying out the work so that the labor bill is low. Where it is possible to have a greater drop, and, consequently a lighter wire, and in some cases less labor in handling it, the choice becomes self-evident. When the cost of labor is equal in both cases, saving can only be attempted with the copper and the reverse, namely, when the cost of copper is equal in both cases saving must be attempted in the labor. Perhaps this idea can be best illustrated by a practical case. Suppose 100 amperes are to be supplied to a set of feeders and branches, will it be necessary to use one or two pair of mains? If the wires are to be laid in moulding and run a distance of 100 feet, a calculation will show the size of wire required. According to the method a knowledge of the drop to take place in the mains is necessary. If the entire drop is 3 per cent., an arbitrary choice of 1 per cent. can be considered, which at the usual voltage of 110 would mean 1.1 volts. The circular mils required are then $100 \times 200 \times 11 \div 1.1 =$ 200,000, corresponding to a No. 4—0 wire whose diameter is .4600 of an inch. If the wires are run straight ahead there is a possibility of using such a heavy wire but where there are bends, it is much more advisable to run two mains of 100,000 circular mils apiece or about No. 0 wire. This is true where moulding is used, although many might raise objections to this conclusion on the grounds that it costs less to run a single line of 200,000 circular mils than two lines of 100,000 circular mils apiece. This matter can only be decided by experience and even then a decision would rest largely upon the character of labor employed, which naturally involves questions of strength, skill and speed in the performance of duties.

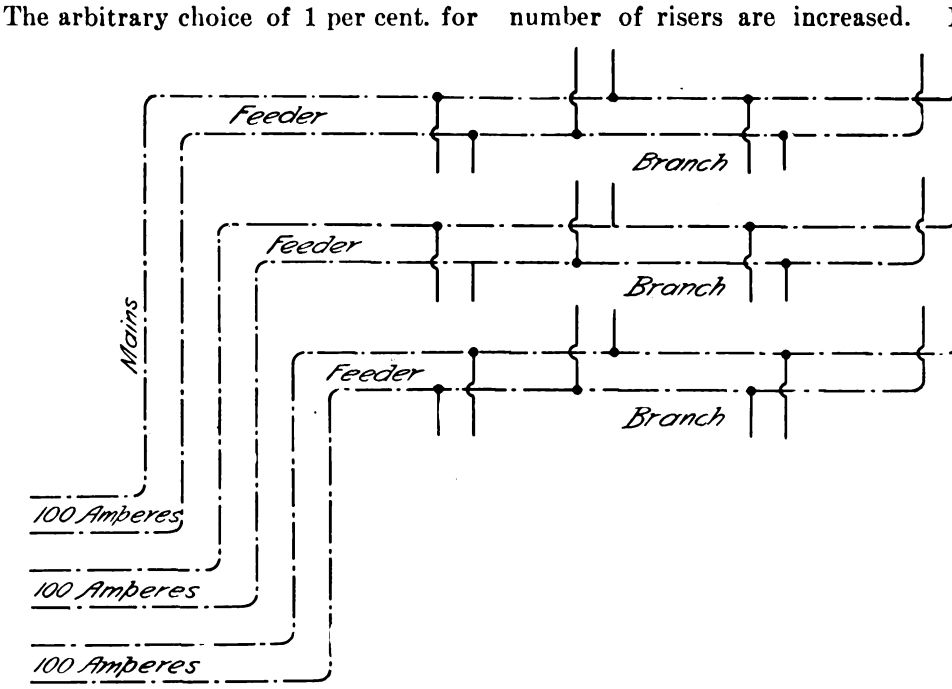
If a single line of 200,000 circular mils is installed there is a saving in cost of material and labor, provided it takes less time to run the wires. A flexible cable might be employed and labor saved, but the wire costs more, so the point to be considered of cost of wire or material and cost of labor is in a practical sense a part of the triple question involved under the head of drop, material and labor.

The arbitrary choice of 1 per cent. for the drop in the mains might have been made 2 per cent.; in which case the size of wire being one-half or 100,000 circular mils, the doubt disappears; but only 1 per cent. drop is left, and it is imperative to divide this up between the feeders and branches. If, putting the copper here, means more labor distributed among a variety of wires, than putting it on the mains, then this is where less drop is most expensive. In the following sketch he elements of a wiring system are shown:



ELEMENTS OF A WIRING SYSTEM.

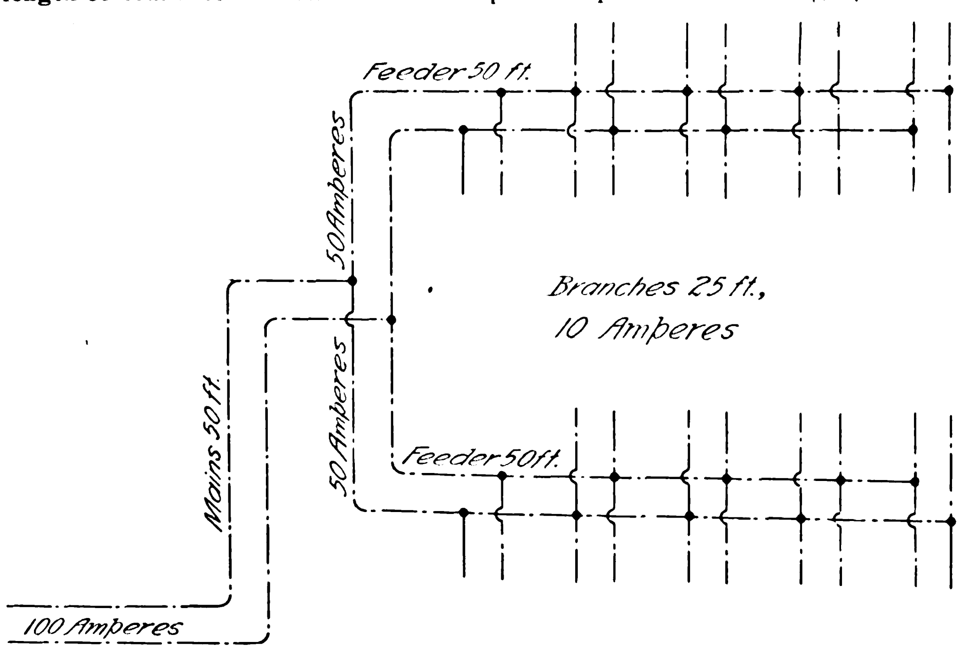
In some cases the wires rising through the building are called "risers," which would give four elements instead of three, called mains, risers, feeders and branches. If the number of amperes are not too great the above system is satisfactory as in the case of a small factory. Where it is necessary to conduct a heavy current to each floor of a building the design is changed in this respect; the number of risers are increased. It is likely in such a case, the number of feeders are also increased, and in all probability the number of branches. But the difference is only in degree, that is to say, the new design would merely be a repetition of the last sketch. A case like this would arise where about 100 amperes are to be used on each floor of a three-story building, as shown in the above illustration:



SYSTEM WITH INDIVIDUAL MAINS.

The foregoing sketches become very elaborate when a large structure is to be wired and every circuit is shown in the drawing. In many cases where the total drop is very small, for instance, 2 per cent., it is very difficult to divide the drop up between the various parts of the system in a scientific manner. The fact of greatest importance is this: that if a certain drop takes place in a building it is due to a certain resistance and a certain current. Although more copper may be used in one part than another, it is evident that the sum total of copper will remain the same although its disposition will change. It is a good policy to make an allowance for overload in the mains and risers, in which case the drop will be less in the mains than any other part of the circuit in proportion to the rest. If for instance 2 per cent. is to be lost in drop and only ½ of 1 per cent. in the mains, this would leave 1½ per cent. for the rest of the circuit. Calculation will show how the sizes of wires would vary under these circumstances. The circular mils of the mains, risers, feeders and branches, on the basis of one estimate, can be compared with the circular mils estimated on a different basis, that is, a different arrangement of the percentages of drop equal to the total allowed. The following case is of interest in illustrating this idea:

Example.—What sizes of wire are required to equip a building for electric lighting at 110 volts pressure, with a 3 per cent. drop, consisting of two floors taking 50 amperes apiece; the length of mains 50 feet, length of feeders 50 feet, and length of branches 25 feet.



Wiring System for Two Floors.

The total drop is 3.3 volts, which may be divided up between the three elements equally for trial figures and for purposes of comparison as follows:

Mains 100 feet wire, mains 1.1 volts drop, mains 100 amperes:

$$C.M = \frac{100 \times 100 \times 11}{1.1} = 100{,}000.$$

Feeders 100 feet wire, feeders 1.1 volts drop, feeders 50 amperes:

$$C.M. = \frac{100 \times 50 \times 11}{1.1} = 50{,}000.$$

Branches 50 feet wire, branches 1.1 volts drop, branches 10 amperes:

$$C.M. = \frac{50 \times 10 \times 11}{1.1} = 5{,}000.$$

Arranging this data in the form of a table will show more clearly the comparison referred to and will embrace all conditions of drop, high and low, for each element of the circuit:

Per cent. drop in volts.	Mains 100 feet. Cir. mils.	Feeders 100 feet. Cir. mils.	Branches 50 feet. Cir. mils.
.1	1,100,000	520,000	55,000
.2	520,000	260,000	27,500
.3	366,667	173,333	18,333
.4	275,000	130,000	13,750
.5	220,000	104,000	11,000
.6	183,334	86,667	9,166
.7	157,143	74,285	7,857
.8	137,500	65,000	6,875
.9	122,222	57,777	6,111
1.0	110,000	52,000	5,500

If possible a table of this character should be drawn up for the various important parts of a wiring system as it will enable an accurate idea to be gained of the size and cost of installation as the percentage of drop in each element is modified.

In the previous example the drop is equally divided between the elements constituting the circuit. If this is not the case the results may be tabulated for convenience and comparison as before. As will be observed the total drop according to the figures is the total allowed, namely, 3.3 volts. All the data is obtained from the last table:

Comparative Table.

	Drop.	Circular mils.	Size wire.
Mains.	.5	220,000	4–0
Feeders.	1.0	52,000	3
Branches.	1.8	3,055	15
Mains.	1.0	110,000	0
Feeders.	.5	104,000	0
Branches.	1.8	3,055	15
Mains.	1.1	100,000	0
Feeders.	1.1	50,000	3
Branches.	1.1	5,000	13

A choice of wires is presented with which the wiring can be successfully accomplished. The first results in the table cannot be used because they call for the use of a 4–0 wire. The second set of results are fairly uniform with the exception of the No. 15 wire, which is too small and forbidden by the fire underwriters. The last set of results are more satisfactory yet capable of further rearrangement to get the correct result. If it is possible to obtain a fair degree of uniformity in the sizes of wire a great advantage is gained as moulding or tubing can be bought to correspond and the work is, in a sense, simplified.

Center of Distribution.—In laying out a wiring system, one of the most important features is the selection of the center, or centers, of distribution. A wiring system is in many respects like a nervous system in its branches and ramifications, but the most interesting fact is the similarity between the ganglions in the nervous system and the centers of distribution in the wiring system. From these points, not only does the current become distributed, but the pressure is delivered as nearly uniform as possible to the various lamps or outlets at which it is utilized. An examination of the wiring of a large building discloses the fact that at one or more points on the floor, panel boards are in use, from which many lines run to lamps, or groups of lamps on the same floor. In smaller buildings the distribution may be different. One panel board may suffice for more than one floor, or, in other words, the centers of distribution are fewer, because the demand for current at given points is less.

Example.—A single case may serve to illustrate the advantage gained by choosing a center or centers of distribution so far as the question of drop is concerned. Suppose a line 1,000 feet long consisting of No. 10 wire is supplied with current at 110 volts pressure and 10 lamps are to be lit at each end of the line; which is the best way of feeding current to the line so as to keep the drop at a minimum? If the current is supplied from one end, the drop would be $C \times R$ = current of 20 lamps × resistance of 2,000 feet of No. 10 wire = $10 \times 2 = 20$ volts. According to these figures the lamps nearest to the point at which the current enters would receive 110 volts minus 10 volts or 100 volts, and the lamps at the distant end 1,000 feet away would receive 10 volts less or only 90 volts. This would mean a heavy reduction in candle power and the failure of the plan as a successful wiring system. On the other hand, supposing the current is fed into the middle of the line, making this the center of distribution instead of the end, the conditions would then be different and the drop greatly reduced. Under these circumstances the current travels from the middle of the circuit 500 feet to each end of the line. The drop for each group of 10 lamps at either end of the line is then equal to: Current of 10 lamps × resistance of 1,000 feet of No. 10 wire = $5 \times 1 = 5$ volts drop. This means a great reduction in the drop for the lamps, uniformity of pressure for the lamps, and a much more efficient use of the copper employed in the line. If, instead of feeding into the middle of this 1,000 foot circuit, two lines or feeders are run 250 feet away from the ends, the drop for each group of lamps becomes: Current of 10 lamps × resistance of 500 feet of wire = 5 amperes × ½ ohm = 2.5 volts drop.

The above figures are instructive in showing how the point or points from which the current is distributed will influence the light or drop of the lamps. The following table indicates the effect of these changes:

Ohms.		Length of No. 10 wire. Feet.	Amperes.	Drop in volts.
2	Feeding at one end.	2,000	10	20
1	Feeding at middle.	1,000	5	5
⅔	Feeding at ⅓ from end	666	5	3.333
½	Feeding at ¼ from end	500	5	2.500

This idea is of the utmost value in street railway work, which in many respects possesses all the qualifications of a wiring system. The trolley wire is one leg of the circuit and the tracks the other, and between the positive and negative wires thus indicated, instead of lamps, as in the system of incandescent light wiring, trolley cars are running. The current these cars take is the cause of a heavy drop on the line, which is to a large extent reduced by connecting into the line at definite points, feeders which supply both current and pressure where it is most necessary. By this means, a comparatively uniform pressure is preserved throughout the line under all conditions of load.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE IX.

BY W. H. WAKEMAN.

Fig. 17 illustrates a dome in which are found several good features. Steam passes from the shell into this dome through a hole that is practically the full size of dome. This insures dry steam because there is nothing in the design to cause water to lift, as mentioned in connection with other forms.

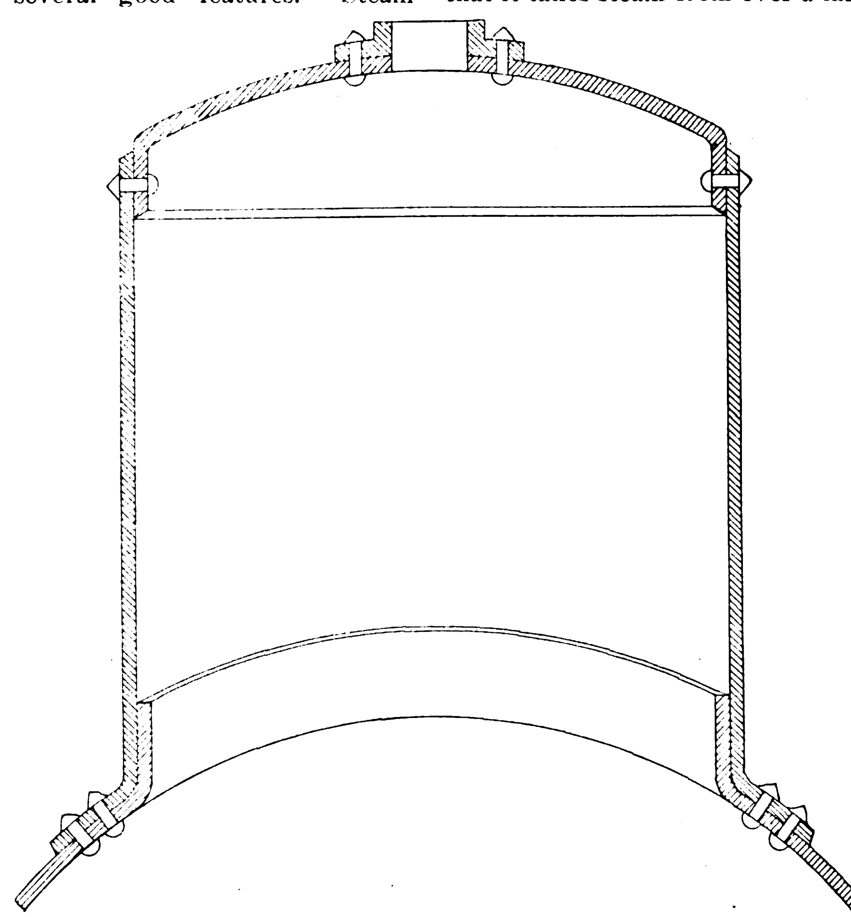


FIG. 17.

The shell is flanged upward, forming a stiffening ring that makes the whole much stronger than it otherwise would be. The head is "bumped up" thus giving it the strongest form possible, requiring no braces. A combined reinforcing ring and flange is riveted to the steam outlet at the top.

Fig. 18 is another dome with a full size opening from the shell. The reinforcing ring held in place by a double row of rivets is a valuable feature. As the shell is flanged upward at this point, it adds much strength to this part of the boiler, therefore where these precautions are observed, a smaller factor of safety can safely be allowed when determining the working pressure that can be carried. The top does not need bracing.

Due consideration of the foregoing explanations relating to domes will show that they form a prominent reason for the use of a large factor of safety, as ordinarily designed and constructed.

Fig. 19 shows the operation of a very good substitute for domes, called a dry pipe, because it delivers dry steam to the engine. This result is due to the fact that it takes steam from over a large part of the water surface, through many small holes provided for this purpose. It certainly does not act as a reservoir for steam, because it adds nothing to the storage capacity, yet it is considered valuable by many engineers. Its application does not weaken the shell, which is a strong point in its favor.

Another feature which makes it necessary to use a large factor of safety is

the necessity for cutting man-holes somewhere in the boiler so that the interior can be reached for cleaning and inspection.

The first change I noted in the design

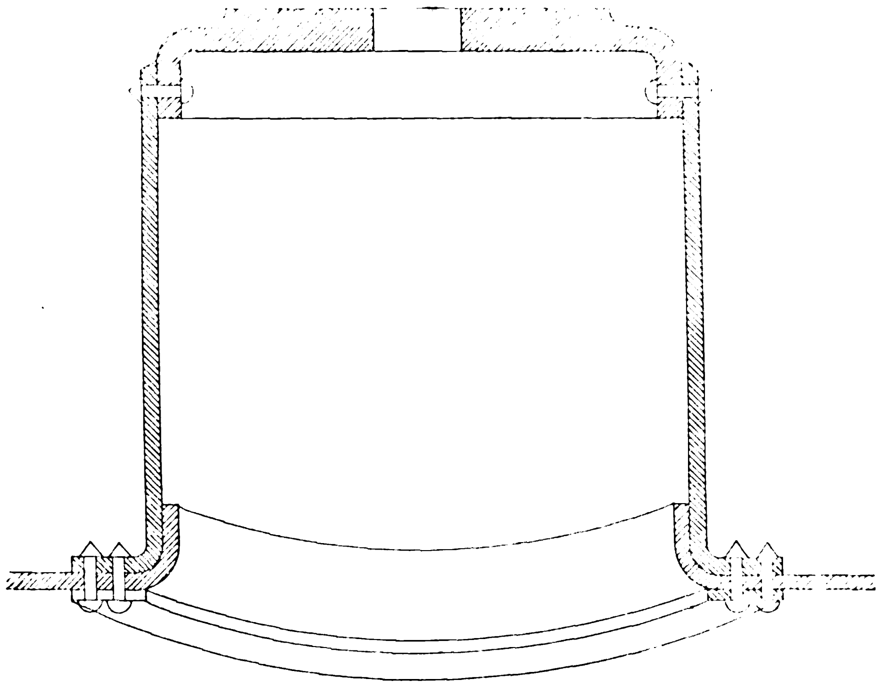


FIG. 18.

of boilers in use, along this line, was removal of the man-hole from head of dome and placing it in the shell just back of the dome. This was an improvement because

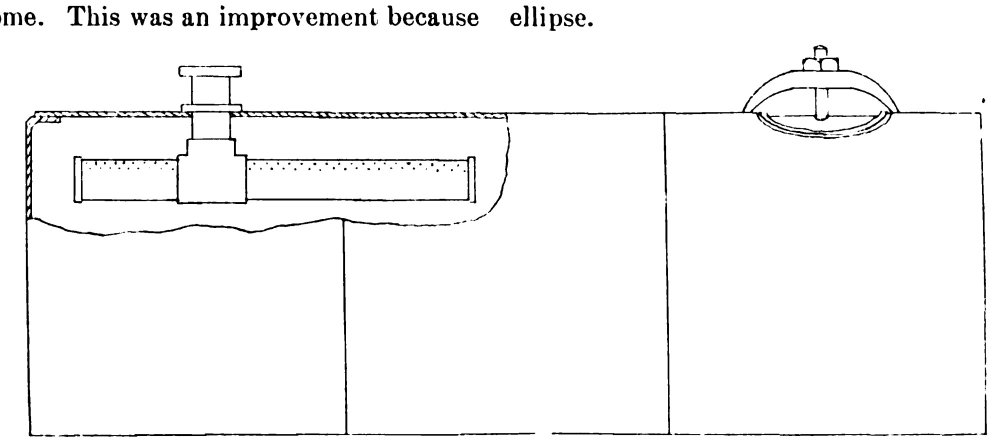


FIG. 19.

the interior of boiler could be reached with less trouble, but it required too large holes in the shell which weakened it, call-

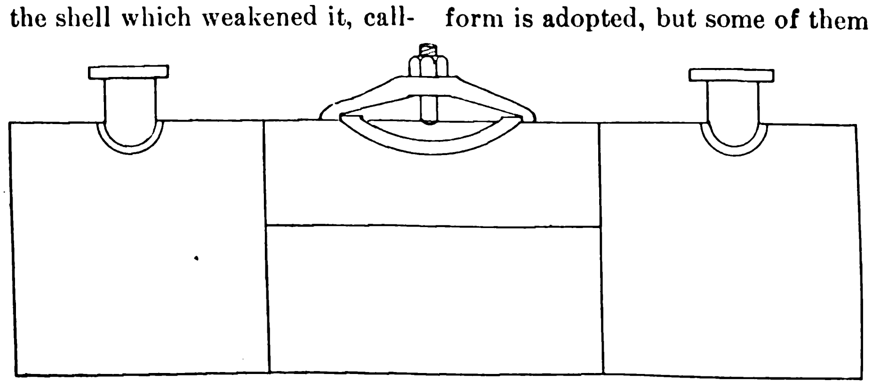


FIG. 20.

ing for a large factor of safety when calculating the working pressure.

The next move noted in this direction was to dispense with the dome, put a man-hole in the middle of shell and a steam nozzle on either side of it, as shown in Fig. 20. The latter calls for comparatively small holes that are strengthened by the base of steam nozzles, which act as reinforcing rings. As these holes are round there is nothing to be said concerning their location, but the man-hole is not round as it is made in the form of an ellipse.

Candidates for admission to engineering societies are sometimes asked why this form is adopted, but some of them cannot tell. If made round the cover would have to be put inside before the boiler was finished, and it could never be removed, which would be very inconvenient in many cases. If made round it would weaken the shell more because more material would be cut away lengthwise of the shell. A good illustration of this is found in Fig. 21, which shows a man-hole of the usual form improperly located as the longer part of ellipse is lengthwise of the boiler when it should be crosswise as shown in Fig. 22.

When it is remembered that we consider the shell of a boiler as a succession of rings 1 inch wide when calculating the safe working pressure, it will be plain that when a man-hole is cut like Fig. 21 it severs more of these rings than when made like Fig. 22, therefore in the former case the factor of safety should be larger if a close calculation is to be made.

Another way of stating it, which is really the best way, is to make due allowance when calculating the bursting pressure, then use a suitable factor of safety, making it uniform for all cases. As this would make quite a change in the manner of proceeding with these calculations it is less practical than to change the factor of safety. Some of the old-fashioned boilers that are referred to in these articles, also some of the new ones that will be presented, are so designed that it is difficult to decide on the best factor of safety, as much depends on the good judgment of the engineer who makes the calculations.

ELECTRIC RAILWAYS IN GERMANY.

The Studien Gesellschaft fur Elektrische Schnellbahnen, of Berlin, has now issued, says the *Electrical Review*, London, the long-expected report relating to the experiments with electric locomotives on the military railway between Marienfeld and Zossen in the vicinity of the German capital. It appears from the report, which deals with the later trials which took place between September and November of last year, and during which speeds of as high as 131 miles an hour were attained, that not a single accident occurred in the whole of that period. The tests have shown, according to the report, that with a good track and high-pressure alternating currents and equivalent rolling stock, it is possible to travel at a speed which had previously not been reached, and that, too, without endangering public safety. It has now been decided by the directors of the Studien Gesellschaft to continue the experiments, and the hope is expressed that the State railway authorities will also support the company in this direction by again placing the military railway at its disposal. The object in view is to make a series of duration trials in order to obtain further

experience, and at the same time to test the application of the single-phase alternating current for high-speed electric railway working. Although the military railway is scarcely suitable for duration trials, it has been selected, at all events provisionally, for the purpose in question. It will be necessary to erect special plant at the Oberspree central station so as to enable the further tests to be carried out.

An appendix to the report of the Study Company for express electric railways definitely shows that the two schemes, which were some time ago briefly stated to have been prepared for the establishment of a high speed electric railway between Berlin and Hamburg, are due to the Siemens & Halske Company and the Allgemeine Electricitats Gesellschaft respectively. In the case of the project is contemplated in the speed to 124 miles an hour. The expenditure on the railway for a 100 miles an hour line is calculated at $31,250,000, and at $35,000,000 for the higher speed. It does not, however, appear that any immediate prospect exists of either of the plans developing into a practical scheme likely to be proceeded with in the near future.

A scheme has been submitted to the Prussian and Saxon Governments which proposes the construction of a long-distance electric railway between Halle and Leipzig. A similar project from another source was brought forward a few years ago, but it did not reach an advanced stage. On the present occasion the proposal, which emanates from the Berlin Allgemeine Company, is soon to assume definite shape. The railway is to

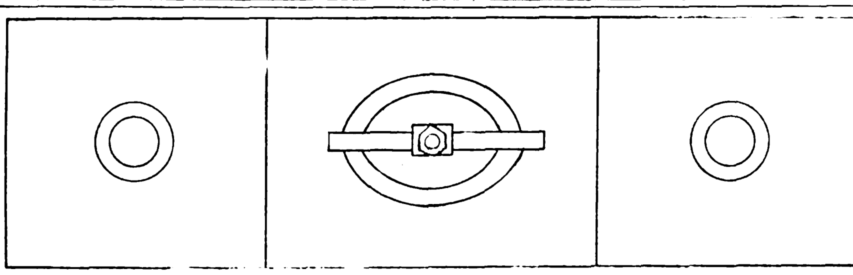


FIG. 21 (Safe Pressures for Steam Boilers).

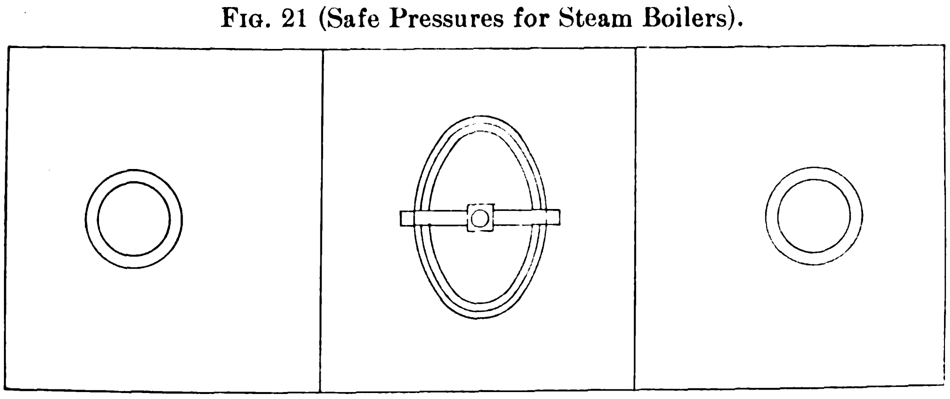


FIG. 22 (Safe Pressures for Steam Boilers).

elaborated by the Siemens & Halske Company, the construction is proposed of a single line with the trains utilizing, in the towns, the tracks of the existing railways by way of a beginning. The expenditure is estimated at $17,500,000, whereas that for a complete double track line is computed at $26,250,000. It is suggested that the trains, which would be formed of from three to five cars, would follow each other at intervals of two hours, with a stop at Wittenberg, and the journey between the two cities accomplished in 1 hour and 55 minutes. The scheme of the Allgemeine Company proposes the establishment of a double track railway, with trains composed of three or five cars running at the rate of 100 miles an hour at the outset, and covering the distance in 1 hour and 47 minutes, while the journey would only occupy 1 hour and 25 minutes with a subsequent increase which proceed from Halle via the districts of Bruckdorf, Bennewitz, Grobers, Grosskugel, Schkeuditz, Alt-Scherbitz, Moddwitz, Quasnitz and Wahren to Leipzig. It is intended to utilize the existing streets in these localities for the purpose of the railway, but a special permanent way will be built outside them in order that the trains may attain a high speed of from 37 miles to 50 miles an hour.

Among the various proposals in Berlin may be mentioned the reported intention of the State Railway Administration to transform the metropolitan railway to electric traction. This rumor is, however, premature, and is doubtless due to the experimental results obtained on the suburban line between Nieder-Schoneweide, Johannisthal and Spindlersfeld with the single-phase alternating current system. These trials are to be continued, in so far that the motor carriages under test are to be brought experimentally into use in the course of the next few months for the regular haulage of passenger trains. In the meantime it may be noted that the extension is now assured of the elevated and underground electric railway through the Bismarck Strasse to the Grunewald, or people's park. The work is to be finished in 1906. With regard to the projected electric railway on the Langen suspended system, which is proposed by the Continental Company for Electrical Enterprises, it appears that the company is at present engaged on the preparation of special plans for the route between Gesundbrunnen and Rixdorf. The negotiations on the subject of the construction of the railway—or, rather, of an experimental section of it, so as to allow the system to be judged from an æsthetic point of view—have not yet been concluded with the municipal and Government authorities. On the other hand, the Highways Committee of the Berlin Town Council has just approved a scheme for a municipal underground electric railway from the Kreuzberg to the See Strasse. This railway, which would form a connection between the north and the south of the capital, would be 5 miles in length. It is estimated that the expenditure on the construction and equipment of the line, which has naturally to be considered by the Town Council, would amount to $12,125,000.

REPORT OF THE COMMITTEE ON PROGRESS.*

BY T. COMMERFORD MARTIN.

(*Concluded from page 6.*)

THREE-PHASE CENTRAL STATIONS.

With regard to methods of distribution, it should be noted that last September the city of Dublin, Ireland, put into operation a very interesting four-wire, three-phase distributing system, to the displacement of a single-phase system. The new system is, it is believed, the largest of its kind in the world, although we have three-phase, two-wire systems in cities like Sacramento and Salt Lake City. The old system was started by the municipality in 1892, and at the time of its displacement had connected the equivalent of 16,500 16-cp. lamps. The old plant had a primary voltage of 2,000 with a secondary pressure of 100 volts, and operated with 83 cycles per second. In addition, some street lighting was provided by arc machines. The distribution had been under-

*Abstract of report read before the National Electric Light Association at its 27th Convention, held at Boston, Mass., May 24-27, 1904.

ground from the beginning. The first cables that were laid decayed rapidly, and in 1899 an entirely new system was laid; the secondary pressure changed from 100 to 200 volts, and instead of each house having its transformer, all transformers were grouped into five sub-stations. The system, as operated, never gained favor, and it was finally decided to put in an entirely new plant, though $400,000 had been expended on the old one. As previously stated, the system adopted is a four-wire, three-phase system. Primary current is generated at the entrance of Dublin harbor at 5,000 volts, and transmitted to a sub-station in the city. The secondaries of the sub-station transformers are star-connected, the old 2,000-volt mains being connected on separate phases between the outer points and center point. Twenty new sub-stations are being added, which will supply 200-volt networks, the lamps being connected between the outers of the star and the neutral common return to the center of star. The arcs are supplied with direct current through motor-generators.

The old lighting system was single-phase, current being supplied at 2,000 volts from the main sub-station to five sub-stations, from which low-tension, single-phase networks were fed at 200 volts. These sub-stations and networks are retained, and are, in fact, still fed from the old switchboard at the main sub-station, the step-down transformers already referred to being employed to change the pressure from 5,000 to 2,000 volts between the two switchboards. For this purpose three 250 kw., single-phase transformers have been provided, with a fourth one as spare, and also four 50 kw. transformers (one being spare) for the light-load periods of the day. The primaries of the transformers are delta-connected, and the secondaries star-connected, the middle of the star being earthed. The secondary terminals of the transformers are directly connected to the old high tension board, so that each group of three takes three independent circuits. Any motors on these circuits must be single-phase, and the new motors which come on will all be connected to the new three-phase secondary networks.

The new three-phase circuits are fed from the 20 overground sub-stations, where the current is transformed down to 200 volts, the primaries of the transformers being mesh-connected and the secondaries star-connected, 200 volts being the pressure between the outers of the star and the center point. The secondary networks are all distinct and not interconnected, and four-core cables of various sections are employed for distribution. The lamps are placed between one of the conductors connected to the outer of the star and the fourth conductor, which acts as a common return for the three phases, and is joined to the center of the star and earthed. Theoretically, if the three circuits were perfectly balanced, no current would flow back through this conductor, but in practice it appears that the circuits will be far out of balance, so that the four cores have been given equal section. The motors are to be connected across the phases without the neutral wire being employed. The main reason for the adoption of this system is that it allows of a higher pressure between the three conductors corresponding to the three phases than if the lamps were simply connected on the three phases in the ordinary way. Two hundred volts has to be supplied at the lamp terminals, and by this four-wire connection the pressure between the three main conductors is 346 volts. Thus, even with four conductors of equal section, the total weight of copper employed is diminished. On the other hand, each conductor has to be better insulated, and, what is more important, the method of connection introduces more complications in the junction boxes and increases their size. The low tension cable is laid in the same manner as the high tension cable, except that when the troughing is under the footways its thickness is reduced to .25 inch. In connection with this plant, I may perhaps be permitted to quote briefly an editorial reference to it from the columns of my own journal as follows:

"It is interesting to see an unmitigated polyphase system tried on a large scale under the severe requirements of modern urban distribution. The three-phase star with neutral wire is, perhaps, upon the whole the most promising alternating system for use upon a large scale. It is not quite so simple as a two-phase, four-wire distribution, but saves a large amount of copper, almost as much as an ordinary three-wire, continuous-current system, even with the large neutral used in Dublin. Broadly, all distributing systems which save copper by combining circuits involve in one form or another the question of balancing the load to insure uniformity of voltage. In the early days of the three-phase system great importance was attached to this matter, and it was an objection often strenuously urged. As experience has been acquired, the fear of unbalancing has sunk to its proper plane, and it has been found that with reasonable care there was little to fear. On a distribution fully laid out for three-phase circuits, this load-wandering can be deprived of its injurious tendencies; but where, as in part of the Dublin system, three old single-phase circuits are put in three-phase connection without any material change, there is a considerable possibility of trouble. This sort of thing can be successfully done in cases where it is a very small part of the total load or where, as in wiring large buildings, the secondary drop is rather small; but it must be rather carefully watched, and should be worked over to a pure three-phase form when opportunity offers. The connections are a trifle more complicated in a three-phase system than in an ordinary three-wire system, but the difference is practically inconsequential, and with due care, as good service can be given from one as from the other. Certainly, the new Dublin system will be a vast improvement over the old one, and we doubt not that the results will be highly satisfactory. The frequency is dropped in the new plant to 50 periods, which seems to be becoming rather the standard practice abroad. Here there is a double standard, 60 periods for general service and 25 periods for work with rotaries. Where many motors are to be used or where much of the distribution is to be underground, there is a material advantage in dropping the frequency below 50 periods; but where lighting is to be done by the alternating current, 25 periods is too low. Perhaps there is no single standard frequency that can be settled upon in general practice in view of the complicated requirements, but it would certainly be an advantage if the bulk of the work could be done at a medium frequency which would enable the bulk of the machinery to be available for all purposes. As it now stands, an enormous variety of machines are built to furnish a fairly complete line at each frequency in use, and it would be a good thing if there were greater uniformity in the matter of frequency."

A number of topics have been discussed in this brief report, but it is needless to add that they are few in comparison with those which might be treated. Several of the subjects which have been reserved for discussion have, I notice, been made the subjects of elaborate papers by competent authors; and it has seemed to me therefore that I should be economizing the time of the convention by not making this report any longer than it is. The last two or three conventions have seen a wide extension in range of topics treated in the papers, the Question Box, and other departments, and

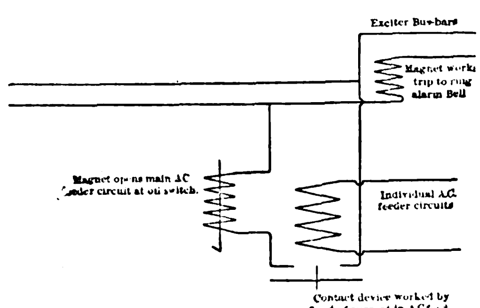
hence the work of the Committee on Progress becomes limited, much to its relief—probably also to yours. It might be noted in conclusion that when the association last met in Boston, in 1887, one great feature of the convention was the discussion of the utilization of electric motors on central station circuits. A vast outgrowth dates from that convention, and it is similarly to be hoped that the present convention, 17 years later, may also serve as a landmark of central station progress along new routes.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

DEVICE FOR OPENING ALTERNATING-CURRENT CIRCUITS.

Another little item that may be of interest is the arrangment of automatic cut-out and alarm on alternating current



circuits. This arrangement is explained by the accompanying cut.

H. SCHREIBER, Augusta, Ga.

RUNNING AN ALTERNATOR WITH TWO COILS BURNED OUT.

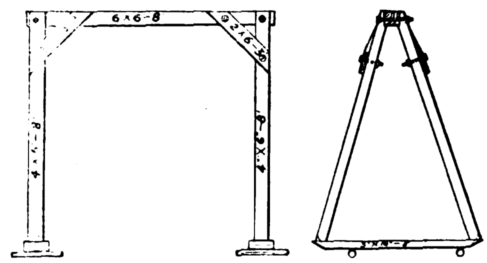
One of our 700-light Westinghouse alternators burned two coils out of its surface armature windings. We cut them out, and continued to carry its full load for several weeks until our extra armature returned from being rewound, which was a surprise to us.

D. L. DAVIS, Salem, O.

A HOME-MADE TRAVELING CRANE.

This is an overgrown "saw-horse," made high enough to swing the upper half of the fields of a generator or motor, or other piece of machinery, with the chain blocks. The beam is long enough to allow of the legs being far enough apart to straddle the machines we want to handle; the feet are beveled to fit, and are toe-nailed to a 3 inch plank, which is just long enough to take the two legs on each end of the beam; each end of these planks are beveled from the bottom so as to take readily a 2 inch roller, which should be about 1 inch long.

We used for ours one piece of plank 6 inches by 6 inches by 8 feet for the beam, four pieces 4 inches by 6 inches by 8 feet for the legs, four pieces 2 inches by



ELEVATION OF CRANE.

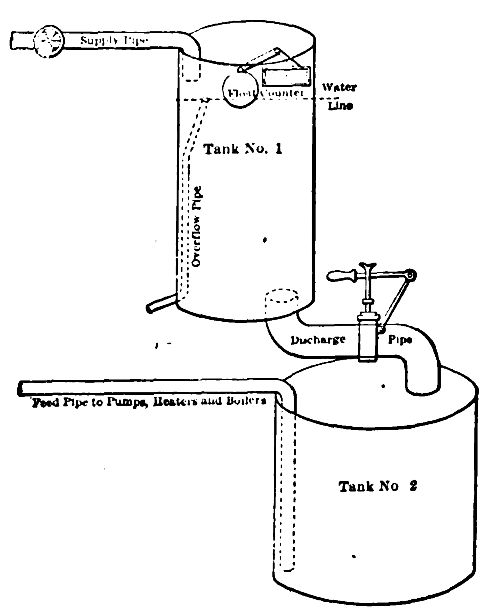
6 inches by three feet for braces, and two pieces 3 inches by 10 inches by 5 feet for the sills, all bolted together, except the tacking of the feet to the sills, so as to be taken apart and assembled as required.

Two men handle our fields and armatures very nicely with this, rolling them to whatever parts of the building desired, and when not in use it is stowed away, and is quickly assembled when needed.

S. S. INGMAN, Georgetown, S. C.

A SIMPLE APPARATUS AND METHOD FOR MEASURING THE WATER EVAPORATED WHEN MAKING EVAPORATION TESTS OF FUEL, BOILERS, ETC.

In the early years of my connection with the electric business, when making evaporation tests, we used to stand a barrel on a platform scale, fill it full of



APPARATUS FOR MEASURING WATER EVAPORATED.

water, weigh it, and pump it into the boilers. We had to work lively at times to fill and empty the barrels fast enough to quench the excessive thirst of the boilers when working under rush conditions during the peak of the load. I conceived the idea of the following apparatus, which was connected up by our engineer: First, a wooden tank of about 300 gallons capacity, which we will call No. 1. The supply pipe was extended to the top of this with a valve placed conveniently for turning the water on and off. A discharge pipe was taken from the bottom of the tank fitted with a gate valve, the pipe and valve being of sufficient size to allow the tank to be quickly emptied. Inside of the tank was an overflow tank, open at both ends, the top of same being level with the water line when the tank was full, the bottom of the pipe protruding from the side at the bottom of the tank. On the side of the tank near the top was placed a counter, the lever of which was attached to a float in the tank.

A little to one side and below the first tank was a larger one, which we will call No. 2, set in the ground that received the discharge from the first tank. To this second tank was connected the feed-water pipe to the pumps, heaters and boilers.

I submit herewith a diagrammatic sketch of the complete apparatus:

Method of Operation.—Open valve in supply pipe; when water first comes out of overflow pipe (indicating that tank is full), close valve in supply pipe and open gate valve in discharge pipe until the tank is emptied, the float falls and the numbering device automatically adds one to the number of times the tank has been previously filled and emptied. The weight of a tank full of water is found by filling tank No. 1 a sufficient number of times for accuracy, carefully weighing same and taking the average.

This scheme has been in use in our station for over 10 years, and during that time has been adopted by several other concerns. It is crude, but easy to install and operate, requires practically no repairs, and has proven very satisfactory. Being a permanent fixture, a test can be made at any time without the annoyance and delay of getting ready to do it.

WM. R. GARDENER, Pittsfield, Mass.

LINE TRANSFORMER USED TO BOOST OR DEPRESS THE FEEDER VOLTAGE TO HELP OUT TEMPORARILY.

I submit the following as a wrinkle that has sometimes been used successfully, although there are objections to its use for any length of time:

To compensate for a temporary drop in an alternating line feeder, a transformer, whose secondary had the same current-carrying capacity as the feeder, was connected with the primary on the bus-bar side and its secondary in series with the line, thus boosting the primary feeder voltage. By reversing the secondary the

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

feeder voltage could be cut down. While this plan would not be recommended for regular service it can sometimes be used to advantage to help out in case of urgent necessity, or to overcome excessive line drop on temporary feeders where expense would otherwise prevent the use of sufficient copper to obtain requisite voltage.

N. F. WILCOX, Lowell, Mass.

The Utilization of Electric Power in Italy.

In the course of an able report on the industrial development of Italy, Mr. A. Percy Bennett, Commercial Attache to the British Embassy at Rome, points to the remarkable increase in the utilization of electric power in Italy since 1890. There are no statistics as to the collective horse power of the various small plants scattered over the peninsula in 1890, but it is improbable that the total electric motive force available in Italy in that year exceeded 20,000 hp. To-day electricity in Italy provides a total motive force of over 200,000 hp.

Milan alone disposes of 20,000 hp., and the large new hydro-electric station at Vizzola, near Milan, distributes 18,000 hp. to various points in the provinces of Milan and Como. Other stations of importance in Lombardy are those of Calvagese, Varese, and Campodolcino. In Piedmont four plants belonging to the Societa Alta Italia were erected between 1890 and 1901 at Lanzo, Bussoleno, Stambinello, and Germagnano, generating a total force of 12,000 hp. Other important plants erected since 1890 are those of Cossogno, in the province of Novara, and of the Company Casalene in the province of Alessandria. Further, in Lombardy and Piedmont, especially in the provinces of Turin, Novara, Bergamo, Brescia, and Como, numerous plants have been erected which distribute a total motive force of over 5,000 hp.

The central station at Genoa generates and distributes over 8,000 and those of Rome and Naples over 10,000 hp. respectively. The new plant at Cellina will shortly be in a position to distribute a motive force of about 18,000 hp. to the provinces of Udine, Treviso and Venice. In Umbria there are two big plants utilized by local factories distributing over 15,000 hp. In 1890 electric traction was only utilized on the Florence-Fiesole line to-day, in addition to the complete urban and suburban lines at Milan, Naples, Rome, Genoa, Florence, Leghorn, Palermo, Perugia and Varese, there are the electric lines of Milan-Monza, Milan-Gallarate-Varese, Lecce-Colico, Terni-Collestatte, Lecce-San Cataldo and some few lines on the Italian Riviera.

In the aggregate there are over 500 kiloms. of rail and tram in Italy served by electricity. In 1890 there were about 400 communes in Italy either partially or totally lighted by electricity. To-day electric light is general in at least 600 communes. The development of the application of electricity to industrial purposes in Italy is very marked, and with a continued adaptation of the water-power with which the country is so richly provided, greater progress in this direction may be confidently anticipated.

THE ELECTRICAL CONGRESS.

Details of the Trip to St. Louis Arranged by the American Institute of Electrical Engineers.

The following are the general arrangements for the reception of visiting electrical engineers attending the International Electrical Congress, under the auspices of the American Institute of Electrical Engineers:

The International Congress will convene at St. Louis, beginning at 9:30 A.M., on Monday, September 12. The opening ceremonies of the Congress will be held in the Music Hall of the Coliseum, at Olive and 13th streets. The meetings of the eight sections will follow, commencing at 11 A.M., in the section halls on the second floor of the Coliseum, the sections adjourning on Monday at 1:30 P.M.

On Tuesday, Thursday and Friday the sections will meet on the second floor of the Coliseum at 9 A.M., and will adjourn not later than 1 P.M.

On Wednesday at 10 A.M. the annual convention of the American Institute of Electrical Engineers will be formally opened at Festival Hall in the grounds of the Louisiana Purchase Exposition, and the President of the Institute, Mr. Bion J. Arnold, will then deliver the annual address. Immediately afterward a topical discussion will follow between the Institution of Electrical Engineers of Great Britain and the American Institute of Electrical Engineers, the subject of which will be announced later. Arrangements are being made for holding a closing meeting of the International Congress and this will probably be held in one of the buildings in the grounds of the Exposition.

The International Electrical Congress is held under the auspices of the Louisiana Purchase Exposition and the following bodies in America are co-operating in the holding of the Congress: American Institute of Electrical Engineers, American Electrochemical Society, American Physical Society, National Electric Light Association, Association of Edison Illuminating Companies, International Association of Municipal Electricians, and the American Electro-Therapeutic Association.

The American Institute of Electrical Engineers has extended an invitation to the Institution of Electrical Engineers of Great Britain to visit the United Sates in September and to hold a joint meeting in St. Louis in connection with the International Electrical Congress. This invitation has been accepted by the Institution of Electrical Engineers, and a large number of its members, many accompanied by ladies, are expected to arrive in this country by the White Star steamship Republic reaching Boston, September 2.

A general invitation has also been extended to European electrical engineering societies to join in a circular tour, visiting principal cities and important industrial centers, organized by the American Institute of Electrical Engineers for the reception and entertainment of its guests and visiting electrical engineers. A number of acceptances have already been received from European electrical engineers and a large delegation of the Associazione Elettrotecnica Italiana, with a number of ladies, is expected to arrive in New York, August 24 and the subsequent days up to September 2, when they will proceed to Boston, joining the main party there on September 3.

A general reception committee and a committee on transportation and arrangements have been appointed by the President of the American Institute of Electrical Engineers and local reception committees have been appointed in the cities which are included in the itinerary of the special circular tour.

For convenience in night journeys and for use between stops at hotels, it is recommended that a commodious hand-bag or dress-suit case be provided, which can be taken in the section or compartment on the train where trunks would be inaccessible. Light weight clothes should be worn, with light weight underwear, with a suit of medium or heavy underwear in reserve.

Traveling rugs are entirely unnecessary. Formal morning and afternoon dress will not be required when making visits from the train, but may be desirable in visits from the hotel at New York, Montreal, St. Louis and at Washington.

While in New York, on Sunday afternoon, September 4, the visiting electrical engineers, and all the members of the American Institute of Electrical Engineers, will be the guests of Messrs. J. G.

White & Co., on a steamboat excursion either up the Hudson or down to Coney Island, as may be arranged later. On Monday, September 5, the visiting engineers and the members of the American Institute of Electrical Engineers, as guests of the New York Reception Committee, will make a tour of the electrical power stations of New York City. On the evening of September 5, a reception and dinner will be given by the American Institute of Electrical Engineers to all foreign visitors.

In order that the visiting members of the Institution of Electrical Engineers and other visiting electrical engineers may have an opportunity of seeing as many as possible of the larger cities of the country and important centers of electrical development, within the time which can be spared, a special circular tour has been arranged by the American Institute of Electrical Engineers. It is strongly recommended that as many as possible of the visitors from abroad avail themselves of this circular tour, as it will afford an exceptional opportunity of visiting many of the important points and places of interest with the greatest economy of time, and at the minimum of expense. It will also afford the local reception committees a much desired opportunity of extending to the visiting electrical engineers the hospitality of their respective cities.

The chairman of the Committee on Transportation and Arrangements, is Mr. E. H. Mullin, 44 Broad street, New York City.

Mr. J. W. Lieb. Jr., 55 Duane street, New York City, is chairman of the General Reception Committee.

Wire Rope Not a Modern Invention.

The wire rope is generally considered a modern invention, a product of modern skill, and it will surprise many to learn that its manufacture is really a re-discovered lost art. The excavations at Pompeii have brought to light a piece of bronze wire rope, nearly 15 feet long, and about 1 inch in circumference. This rope is now in the Musio Borbonico, at Naples.

The Australian Tariff.

Various supplemental changes have been made in the Australian tariff during the past year, and among them are the following of interest to the electrical industry:

India-rubber strips, otherwise known as electrical tape, free.

Insulators, glass, used with accumulators, 20 per cent. ad valorem.

Electric cycle lighting sets, 12½ per cent. ad valorem.

Electrical bolts, unattached, being parts of insulators which accompany them, free.

Incandescent lamp caps, being parts thereof, and not otherwise usable, free.

Electrical discharge keys, free.

Metal glass straps for meters, 12½ per cent. ad valorem.

Electric grip cords, wood, 12½ per cent. ad valorem.

Electric head bands, for attachment to laryngoscopes, free.

Electric pocket lamps, 15 per cent ad valorem.

Glass rod separators, for accumulators, 20 per cent. ad valorem.

Glass shades for arc lamps, 20 per cent. ad valorem.

Porcelain electric tubes, free.

Electrical searchlights, 12½ per cent. ad valorem.

Zinc plates, cut to size for electrical purposes, 12½ per cent. ad valorem.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 5, 1904.

Electric Railways and Appliances.

763,964. Safety Train-Controlling System. George W. Cohen, Allegheny, Pa., assignor to the Cohen Automatic Electric Block Signal Company. Filed Oct. 1, 1903.

764,039. Overhead Trolley. Clide C. Chambers, Everson, Pa. Filed Feb. 25, 1904.

764,148. Third-Rail Guard for Electric Roads. John S. Payne, Midlandpark, and James S. Payne, Wortendyke, N. J. Filed July 23, 1903.

764,194. Trolley-Pole. Caleb Jones, London, Ky. Filed Dec. 17, 1903.

764,211. Current-Collector for Electric Railways. Frederick R. Slater, Yonkers, N. Y. Filed Dec. 5, 1903.

764,224. Trolley. John Q. Brown, Oakland, Cal. Filed April 12, 1904.

764,244. Third-Rail System for Electric Railways. Washington H. Kilbourn, Greenfield, Mass. Filed Oct. 1, 1903.

764,255. Car-Fender. Alfred Robinson, Pittsburg, Pa. Filed Mar. 24, 1904.

764,317. Car-Fender. Philip Todd, Homestead, Pa. Filed April 12, 1904.

764,371. Trolley-Wire Replacer. John D. Ratliff, Muncie, Ind. Filed Feb. 15, 1904.

764,384. Insulating-Support for Electric Third Rails. Frederick R. Slater, New York City, assignor, by mesne assignments, to Bleecker S. Barnard, same place. Filed May 28, 1903.

764,388. Electric Railway. Henry N. Sporborg, Rugby, Eng., assignor to the General Electric Company. Filed Dec. 9, 1902.

764,392. Trolley. Bernard E. Sunny, Chicago, Ill., assignor to the General Electric Company. Filed Dec. 10, 1903.

764,400. Out-Out for Trolley-Conductors. Pendleton G. Watmough, Jr., Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 1, 1901.

764,418. Multiple Trolley. John S. Briggs, Los Angeles, Cal. Filed June 1, 1903.

Electric Lights and Appliances.

764,005. Glower Support for Second-class Conductor Lamps. Henry N. Potter, New Rochelle N. Y., assignor to George Westinghouse, Pittsburg, Pa. Filed Oct. 9, 1902.

764,037. Hanger-Handle for Electric Lights. Patrick J. Cahill, Utica. N. Y. Filed Sept. 17. 1903.

764,105. Electric-Arc Lamp. Andre Blondel, Paris, France. Filed Dec. 22, 1903.

764,135. Electric-Light Hanger for Walls. Willy H. Lau, Chicago, Ill. Filed April 23, 1904.

Electrical Machinery and Apparatus

764,189. Electric Switch. James F. Hardy, New York City, assignor to the Consolidated Dental Manufacturing Company, same place. Filed March 4, 1903.

764,218. Electric-Circuit Controlling Apparatus. Jacob P. Tirrell, Boston, Mass., assignor, by mesne assignments, to Jay B. Crawford, same place. Filed Oct. 10, 1903.

764,240. Electrohydraulic Valve Mechanism for Elevators. Herbert F. Hinman, New York City. Filed April 26, 1902. Renewed June 3, 1904.

764,253. Electric Meter. Albert Peloux, Geneva, Switzerland, assignor to Societe Anonyme des Ateliers de Mecanique de Precision de Territet, Territet, Switzerland. Filed April 13, 1903.

764,293. Electric-Circuit Cut-out. Charles Johnston and Claude Johnston, Memphis, Tenn Filed Aug. 20, 1903.

764,372. Thermal Cut-out. Robert H. Read Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 23, 1902.

764,439. Controlling System for Electric Motors. Arthur C. Eastwood, Cleveland, O. Filed March 21, 1904.

764,451-764,452. Bucket Construction for Turbines and Turbine Bucket Cover. Henry Geisenhoner, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 19, 1903.

764,471. Turbine. Oscar Junggren, Schenectady, N.Y., assignor to the General Electric Company. Filed Dec. 18, 1903.

764,480. Motor-Control System. John B. Linn, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 11, 1901.

764,481. Field-Coil and Method of Making Same. Walter D. Litchfield, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 10, 1902.

764,485. Transformer. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 14, 1903.

764,505. Electric Switch. John L Steeb, Butler, Pa., assignor of two-thirds to William M. Carnahan and Frank M. Megogney, Pittsburg, Pa. Filed Sept. 29, 1903.

Telephones and Telephone Apparatus.

763,970. Party-Line Telephone System. Thomas C. Drake Malta, O. Filed Feb. 13, 1903.

763,971. Ringer System for Telephone Exchanges. Thomas C. Drake, Malta, O. Filed April 14, 1903.

763,972. Automatic Selecting Apparatus and System. Joshua T. Fisk, Adrian, Mich., assignor to George P. Fisher, Jr., trustee, Chicago, Ill. Filed Jan. 8, 1902.

764,055. Telephone-Transmitter. Dugald C. Jackson, Madison, Wis. Filed Sept. 26, 1902.

764,139. Telephone. John W. Mead, Harry A. Mackie and Martin Van Buren, Amsterdam, N.Y., assignors to said Van Buren and John J. Turner, same place. Filed Oct. 19, 1903.

764,143. Circuit-Changer for Telephone-Switchboards. William E. McCormick, Chicago, Ill., assignor to the International Telephone Manufacturing Company. Filed Aug. 26, 1901.

Miscellaneous.

764,020. Electrically-Propelled Vehicle. Russell Thayer, Philadelphia, Pa. Filsd April 11, 1904.

764,093-094. Wireless Telegraphy. Leonard D. Wildman, U. S. Army. Filed June 10, 1904.

764,174-178. Thermo-Electric Element and Apparatus. William H. Bristol, Hoboken, N. J. Filed April 4, 1904; May 5, 1904.

764,176-177. Thermo-Electric Couple. William H. Bristol, Hoboken, N. J. Filed April 4, 1904; March 5, 1904.

764,181. Starter for Vapor Electric Apparatus. Charles W. Denny, New York City, assignor to the Cooper-Hewitt Electric Company. Filed Jan. 27, 1904.

764,199. Alarm-System Apparatus. Felix McGloin Brooklyn, N. Y. Filed May 23, 1903.

764,213. System of Electrical Distribution. Charles P. Steinmetz, Schnectady, N. Y., assignor to the General Electric Company. Filed Jan. 23, 1895.

764,282. Battery-Cell. William O. Duntley, Chicago, Ill. Filed Feb. 15, 1904.

764,391. Electrical Connection. Ernest A. G. Street, Courbevoie, France, assignor to la Societe Anonyme le Carbone, Levallois-Perret, Paris, France. Filed July 15, 1903.

764,469. Telpherage System. John H. Johnson, Dodgeville, Wis., assignor of two-thirds to George A. Lee and Anton Dyreson, same place. Filed July 18 1903.

764,533. Automatic Electric Block-Signaling. William A. Luby, Kalamazoo, Mich. Filed May 9, 1903.

764,539. Automatic Electrical Display Apparatus. Bernard A. Gilbert, Philadelphia, Pa., assignor to Lillian T. Gilbert, same place. Filed June 10, 1903.

THE TELEPHONE WORLD.

Officers Elected for the Indiana Independent Mutual Telephone Association.

At the recent convention of the Indiana Independent Mutual Telephone Association held in Lafayette the following officers were elected: Theodore Thorwald, of South Bend, president; C. A. Reeves, of Plymouth, vice-president; J. W. Johnson, of Elkhart, secretary.

The nominating committee was composed of J. G. S. Vandersen, of Michigan City; D. E. Miller, of Flora; Elmer Sweitzer, of Crawfordsville. The president, vice-president and secretary were appointed a legislative committee. C. S. Norton, Indianapolis; H. A. Barnhart, Rochester, and John Bell, of Salem, were appointed a committee to effect a standardization of toll line apparatus. Mr. Thorwald, in his speech, urged a closer co-operation in toll business. At his suggestion the association empowered the president to appoint a committee of four, besides himself, to arbitrate toll matters.

At a regular meeting of the directors of the Iowa Telephone Company at Davenport, a short time ago, the affairs of the company were found to be in a good condition and a dividend was declared. Those present included President C. E. Yost, of Omaha; General Manager E. B. Smith, of Des Moines; Secretary and Treasurer, J. B. Mason, of Des Moines, and Directors F. H. Griggs, E. E. Cook, Joe R. Lane and George W. Cable, of Davenport. While the headquarters of the Iowa Telephone Company have been removed to Des Moines, Davenport will continue as the meeting place of the directors.

At a recent meeting of the stockholders of the Union Telephone Company, held at Trump, Md., the following officers were elected: President, Charles L. Almony; secretary, treasurer and manager, James R. Jordan: executive committee: James R. Jordan, George L. Winemiller and Dr. Millard Stir ing. The officers of the company constitute the board of directors. It was also decided to increase the capital stock of the company, and to extend its lines to Bradenbaugh, Harford County, and to Freeland Station, on the Northern Central Railway.

It is said that in Richmond, Ind., the Home Telephone Company has one telephone to every 10 inhabitants. The company has recently inaugurated an information service for the U. S. weather reports. Between 7 and 8 o'clock every evening all the lines will be given the general signal, which consists of six short rings, and then the weather report for the next 24 hours will be read.

The Merton, Minn., Rural Telephone Company has been organized to construct a line from Owatonna to Merton. The officers are: L. D. Carleton, president; N. O. Partridge, secretary, and James Mooney, treasurer.

The Egg Harbor City, N. J., Telephone Company has opened its Independent exchange there with 75 subscribers. The company is composed of Egg Harbor business men, and is local as well as long distance.

The Alamo Telephone Company, of Alamogordo, N. M., will extend its lines to Weed.

New Suburban Telephone Service Planned in Missouri.

Articles of incorporation of the Suburban Telephone Company were lately filed in the recorder's office in Clayton. The capital stock is placed at $100,000, divided into 2,000 shares of the par value of $50 a share, 10 of which have been subscribed and paid for.

The incorporators are: J. Percival Phelan, of Wellston; James D. Houseman, of Ferguson; W. Lee Travers, of St. Louis; C. R. Black and H. W. Karrenbrock, of Clayton, each of whom holds two shares. The office of the company will be in Clayton, with Mr. Karrenbrock as its agent.

The company was organized for the purpose of providing telephones for the people of St. Louis at rates greatly reduced from those offered by the older companies.

The Home Telephone Company, of San Diego, Cal., which secured a franchise only a short time ago, has commenced the actual work of constructing the system as well as the building of its central offices. All the wires in the business portion of the city will be laid underground in four compartment conduits. The Central Building is to be three stories and basement and the telephone company is to occupy the entire building.

The Newark, N. Y., Telephone Exchange, of which William H. Kelly is the manager, has given notice to its patrons that there will be charge for telephone service beginning July 15, and continuing until after the new service is in operation. The new service will provide the newest and most improved central energy system, the new switchboard having already arrived. This will be supplemented by several miles of cable and the present party lines will be eliminated.

The Petroleum Telephone Company, of Oil City, Pa., will make extension of the lines from Hydetown to Titusville, Townville and Guy's Mills. The Meadville Telephone Company, of Meadville, will construct an extension to Guy's Mills, giving through connection from Oil City to Meadville.

The many attempts made by American companies to operate a telephone system in Manila, have proven fruitless. So far the Government has not made any concessions that would allow a reputable company to engage in business.

Citizens of Pavo, Ga., have organized a stock company for the purpose of installing telephones, with Mr. Parish, of Moultrie, as president.

A petition is in circulation in Swansea, Mass., headed by George W. Fisk, asking that the automatic telephone be established in that town.

It has been rumored that J. B Driggs has purchased the Ohio Valley Telephone Company of Bellaire.

The Delaware & Atlantic Telephone Company is arranging to put all its wires in Wilmington, Del., underground.

The Eureka Telephone Company of Mauckport, Ind., has increased its capital stock from $10,000 to $25,000.

Improvements for Utica, N. Y., Company.

A number of extensions and improvements are about to be made by the Utica Home Telephone Company, among them the laying of 8,000 feet of underground cable. The company is equipping its switchboard so as to accommodate 800 additional subscribers, and in doing this work it will necessitate a large amount of work on the city lines as well as the toll lines. Edward L. Cline, the superintendent of construction, has returned from Cooperstown and Richfield Springs, and other points in that vicinity, where he had a gang of men building lines. The Rome Independent Telephone Company is also getting ready to make several improvements. Two new sections to the switchboard will be made and 20,000 feet of aerial cable will be strung.

There is trouble on between the Bell Telephone Company and the York State Company, over an alleged cutting of wires of the York State Company by Bell line men. York State wires on three poles in Rossville, N. Y., have been cut lately by Bell linemen, according to the allegations of the York State people. Manager Withington says he had permission to use these poles, but says that the Bell Company claims the right also.

The Home Telephone Company, of Cohoes, N. Y., reports that its patronage is increasing daily. A line is being extended to Mechanicsville and another one to Crescent, and along each of the two lines a number of subscribers have been secured.

The Farmers' Telephone Line, northwest of Syracuse, Neb., is making arrangements to construct its lines to Syracuse and connect with the Independent telephone system. Farmers north of that town have about decided to take a similar step.

About 4,600 guests assembled in Salt Lake City, Utah, recently, at the reception in the Independent Telephone Company's building The occasion was the opening of the new building.

The Randolph & Hiseville Telephone Company, of Metcalfe County, Ky., has been incorporated by L. B. Strader, J. H. Owen and E. Evans.

The town board, of Pound, Wis., has granted a franchise to the Farmers & Merchants' Telephone Company of Lena, to build a line through the town.

The sum of $45,000 is now being expended by the Wisconsin Telephone Company in extending and improving its long-distance lines throughout the State.

Linemen of the Central Union Telephone Company, of Peoria, Ill., have struck for shorter hours and more pay. They ask for $3 per day of eight hours. They now get $2.50.

Telephone Incorporations.

The Idaville Co-Operative Telephone Company, Idaville, Ind. Capital stock, $9,000. Directors: John B. Wright, John H. Mourer, T. G. Melvin, T. B. Gime, William Pearson, A. T. Read and John Reiff.

GENERAL ELECTRICAL NEWS.

LIGHTING.

East Lake, Ala.—The board of mayor and aldermen of this place has granted a 30-years' franchise to the Birmingham Railway, Light & Power Company, and the company will at an early date install a system of electric lights here.

Fairmount, Ill.—This village is to have an electric light system in the near future.

Gillespie, Ill.—The Gillespie Electric Light Company has been incorporated with a capital of $15,000 by C. W. Smith, G. W. Schmidt and others, to maintain an electric light and power plant.

Grand Forks, N. D.—The electric light capacity of the Grand Forks Gas & Electric Company's plant will be increased 400 hp. The present capacity is a little less than 200 hp. Another new building is to be erected and also other improvements. The total cost will be $20,000

Hartford, Conn.—The Hartford Electric Light Company will build a new power plant at Dutch Point. This addition is intended as an auxiliary to the several power stations of the company, which will thus be placed in condition for emergencies.

Iola, Kan.—This city has decided to extend the electric lights to the west side suburb.

Memphis, Tenn.—The city council is figuring on the erection of an electric light and water plant.

Missoula. Mont.—The Missoula Light & Water Company, which has been organized under the Oregon laws, with headquarters at Portland and a Montana branch here, will construct an electric light and water plant It has a capital stock of $400,000. G. B. McLeod is president and F. R. Olin, secretary, both of Portland.

Mount Pleasant, Pa.—The Hartigan Electric Light, Heat & Power Company has been incorporated with a capital of $5,000. J. F. Hartigan and J. Lloyd are interested in the scheme.

Newberry, S. C.—This city will install a new electric lighting plant. The council has adopted a resolution authorizing the mayor to execute notes amounting to $4,700, payable in two equal annual payments at 6 per cent. interest in payment for the plant.

Paris, Ill.—The City Gas & Electric Company has been incorporated with a capital of $150,000 by A. J. Baber, W. J. Hunter and J. E. Parrish, to operate a gas and electric light plant.

Pella, Ia.—This city may install a new electric light plant.

Seattle, Wash.—This city is about to build a municipal electric lighting sub-station that will cost $18,000.

Slater, Mo.—W. R. De Witt has been granted a franchise to install an electric light plant here.

Springfield, Minn.—The board of mayor and aldermen of this place has secured the services of Granberry Jackson, a civil engineer of Nashville, to prepare plans and arrange for bids, and also to superintend the erection of the waterworks and electric light plant after the contracts are let.

St. Joseph, Mo.—An ordinance providing for the issuance and sale of improvement bonds to the amount of $75,000 for purchasing a site and building thereon an electric light plant was lately voted upon and carried.

St. Paul, Minn.—The Union Manufacturing Company has applied for a franchise to extend its electric lighting system.

Stillmore, Ga.—An electric light plant is to be installed here.

Thief River Falls, Minn.—The Thief River Falls electric light plant is to be enlarged.

Winfield, Kan.—The proposition to issue bonds for an electric light plant was carried recently.

STREET RAILWAYS.

Aguas Calientes, Mex.—E. P. Shaw, of Boston; E. T. Barnett, a millionaire, of Baltimore, Md.; W. H. Wilkinson, retired capitalist of Boston, and several other prominent Easterners, are interested in a proposed electric road between here and Guadalajara.

Alton, Ill.—The Alton Light & Traction Company, capitalized at $1,000,000, has been merged into the Alton Granite & St. Louis Traction Company, which has a capitalization of $3,000,000. The merger is part of a plan for the construction of an electric railway between this city and St. Louis.

Battle Creek, Mich.—The promoters of the Battle Greek & Coldwater electric road are talking of extending their line to Athens.

Carrollton, O.—The Steubenville & Canton Railway Company, which was recently incorporated to build an electric line between Canton and Steubenville, has applied for a franchise here.

Delphi, Ind.—Bonds to the amount of $2,000 have been given by the Union Traction Company for the right of way here.

Flint, Mich.—The Flint & Saginaw Traction Company has been incorporated to build an electric line from here to Saginaw.

Geneva, O.—The Geneva Electric Railway Company is the name of a new company just organized here with M. Westerman as president.

Healdsburg, Cal.—An electric railway to connect this place with Cloverdale, further up the fertile valley of the Russian River, is now talked of. Alfred D. Bowen says he will build an independent line between here and Cloverdale if he can secure rights of way and other concessions necessary.

Knoxville, Tenn.—The Knoxville Traction Company will build an addition to its power house to cost $10,000.

Latonia, Ky.—The Louisville & Nashville Railroad Company proposes to build an electric line to this place.

Philadelphia, Pa.—The Philadelphia, Lancaster & Harrisburg Passenger Railroad Company is negotiating with the Elizabethtown council in regard to a trolley line from Mt. Joy to Middletown.

Sterling, Ill.—The officials of the Eastern Electric Railway Company are considering extending the road from here to Morrison.

Summit, N. J.—The Morris Traction Company is seeking to build a trolley road across Union County through this place.

Xenia, O.—A new electric line between here and Wilmington is projected. The promoters ask that $100,000 of the bond issue proposed be taken by the people of the localities to be benefited by the road

POWER PLANTS.

Asotin, Wash.—Articles of incorporation of the Lewiston-Clarkston Company have been filed by Edgar H. Libby and G. W. Bailey. The capital is $2,000,000, and includes three power companies, which have merged. The plans for additional development of the electric plants are completed.

Carroll, Ia.—The transmission of electric light and power from the plant here to Glidden is under consideration.

Colima, Mex,—The company recently organized to install an electric power plant on the Naranja River, has acquired the street railway system of this city, of John R. Knight, London. The water will be given a fall of 400 feet, and it is estimated that 1,500 hp. will be developed. The new light plant will cost about $150,000.

Mexico City, Mex.—The formal transfer of Mount Popocatapetl volcano to Capt. Charles Holt, representing a New York syndicate, has been made by Gen. Casper Sanchez Ochoa. The new owners of the volcano will build a cog wheel railroad from the base of the mountain to its summit and establish a great electric power plant.

Millville, Cal.—Another power plant is to be established in Shasta County, which will be located on Clover Creek, near here. The promoter of the plant is F. E. Primm, an attorney of Redding.

Montgomery, Ala.—The Cherokee Development & Manufacturing Company has perfected plans to build a large water power plant at Cherokee Bluff on the Tallapoosa River, and supply electric power to the city of Birmingham, 85 miles away. It is proposed to develop 25,000 hp. to augment the 100,000 hp. now in use there, and in no sense go in competition with the Birmingham Railway, Light & Power Company. Henry C. Jones, of this city, is engineer for the company.

Plainwell, Mich.—Through the efforts of the J. F. Esley Milling Company this city will soon have an electric power plant. The old Stewart planing mill has been purchased by this company, which will erect an electric power house to be equipped with up-to-date machinery.

Red Bluff, Cal.—E. B. Waldbridge and others, who are interested in a new power proposition in this section, have men engaged in surveying the lines for same. The new company is called the Tehama Power & Transportation Company. It proposes to take water from Mill Creek near Morgan Springs over near Mount Lassen and convey it by ditches and flumes to a place east of this city and Tehama. There are three drops proposed in this line and at these places electric power will be generated.

BIDS WANTED.

Washington, D. C.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until July 19, for furnishing the navy yards at Washington and League Island with electrical supplies motors, side wall boxes, wire, etc. Blank forms of proposal can be obtained upon application to the navy pay offices in Philadelphia and Baltimore, or to the Bureau at Washington.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12⅝c.; Lake 12⅝@12¾c.; casting, 12⅛@12¼c.

The sale of the Schenectady Railway by the General Electric Company is generally credited, although it is met with denials.

It seems to be quite generally believed that Electric of America (Philadelphia) will go on an 8 per cent. dividend basis early next year.

The New York & Westchester Lighting Company of Port Chester, Westchester County, was incorporated at Albany on Monday with a capital of $250,000.

The directors of the Bell Telephone Company of Philadelphia have ordered a quarterly dividend of 1½ per cent. paid on the stock July 15.

The United Traction Company of Albany, N. Y., has declared the regular quarterly dividend of 1¼ per cent., payable August 1. Books close July 21 and reopen August 2.

It comes from a reliable source that the directors of the Metropolitan Elevated Road of Chicago will not order resumption of dividends on the preferred stock at their semi-annual meeting next month,

The Georgia Railway & Electric Company has declared a regular quarterly dividend of 1¼ per cent. on the preferred stock, payable July 20. Books close July 14 and reopen July 21.

On July 30 the first dividend rental to the stockholders of the Third Avenue Railway Company will be paid by the New York City Railway Company. The dividend will be 1¼ per cent. for the quarter.

The Twin City Rapid Transit Company (Minneapolis) has declared the regular quarterly dividend of 1¼ per cent. on its common stock, payable August 15. Books close July 30 and reopen August 16.

Frank J. Gould offers to buy at par the coupons of the bonds of the Virginia Electrical Railway & Development Company and the Richmond Traction Company, payment of which was passed. The total in default is about $50,000.

The Milwaukee Electric Railway & Light Company has declared the regular quarterly dividend of 1½ per cent. on its preferred stock, payable August 1. Books close July 20 and reopen August 2.

The activity of Manhattan Transit on the curb in this city is accompanied by a report that it has secured control of the New York & Brooklyn Railway Company which has a charter to build a tunnel under the East River to Brooklyn.

Insiders are buying Boston Edison Electric in anticipation of the August dividend of 2½ per cent. Stockholders will be given the right to subscribe to a new stock issue possibly the last of this year, but probably not until early next year.

Persons interested in St. Louis Transit Company, which controls practically all the electric lines in St. Louis, have been looking forward to a large increase in earnings due to the traffic resulting from visitors to the World's Fair. This company is capitalized at $20,000,000 and guarantees the payment of interest upon all the bonds of the United Railways Company of St. Louis and its controlled companies, and also guarantees 5 per cent. dividends upon the United Railways Company's preferred stock. Notwithstanding the increase in earnings the quotation for the stock has advanced but a point above the price prevailing before the exposition opened.

ELEOTRIOAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price July 11
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	150⅝
Metropolitan Street Railway	115
Metropolitan Securities	87
Ninth Avenue	195
Third Avenue	121⅛
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	50
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	67½
Philadelphia Traction	96½
Union Traction, $17.50 paid	53½
Boston.	
Boston Elevated, full paid	141
West End Street, com	90½
do. do. do. pref	110½
Chicago.	
City Railway	175
North Chicago	71
Union Traction, com	4
do. do. pref	29½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	47
do. do. pref	76
Electric Lead Reduction	½
Electric Vehicle, com	9
do. do. pref	13
Westinghouse, com	158
do. pref	190
General Electric	158¼
Boston.	
Edison Electric Illuminating	244
General Electric	158¼
Massachusetts Electric Companies, com	19½
do. do. do. pref	73
Westinghouse Electric & Mfg., com	79
do. do. do. pref	95
Chicago.	
Chicago Edison	145
National Carbon, com	28½
do. do. pref	101½
Philadelphia.	
Electric Company of America	9⅛
Electric Storage Battery, com	57
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	129
Western Telephone Company	9½
New England Telephone Company	121½
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	180
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	..
Western Union Telegraph Company	87½
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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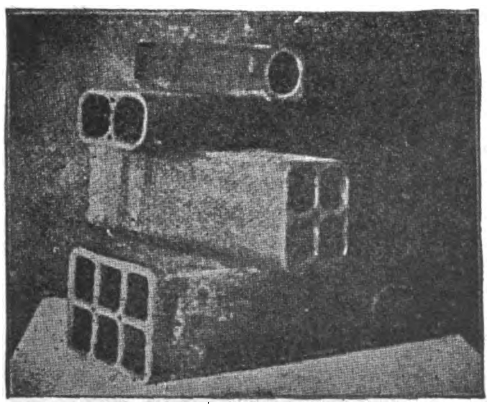

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CONTENTS.

EDITORIAL NOTES.

Debt of Large Cities to Builders of Electric Roads.

The pioneers of progress in the affairs of large cities are not only the legislators and the efficient politicians through whose aid the city is expanded and beautified morally and physically; but the promoters and builders of electric roads may also be rightly included under this classification for their influence in promoting public welfare and happiness.

The attitude of the public in the granting of franchises is generally one of suspicion both as regards the necessity for a new road and the other far more interesting and far-reaching question "who is making the money?" While this is the position the public takes, the question of advantages gained by it is not always considered in a spirit of moderation and fairness. The people are great gainers, individually and collectively, by the present system of electric traction, so characteristic of large American cities. From the standpoint of land values alone, the commonwealth is immensely benefited. Yet in the years gone by the public clamor against the running of cars through New York's greatest thoroughfare, Broadway, called for craft and crime on the part of Jake Sharp to accomplish this object. What would the clamor be to-day if it was proposed to remove this line? Although in main thoroughfares electric roads are now considered indispensable, and land values are high in consequence, the same reasoning applies to points still further removed from business centers, in fact, to land locations on the city limits which would be otherwise inaccessible.

Then the bread-winner must be considered and the advantages he gains in the way of ready and rapid facilities to factory or office while enjoying the benefits of fresh air, moderate rents and suburban surroundings. Instead of living in congested centers with an environment whose reactionary effects threaten the moral and physical fiber of the strongest, the country belt around the city is opened up to the public, the incipient spread of contagion is resisted and the double combination of a country home and a city job becomes a success without the wrecking of nerves, sleep or digestion.

This indeed means the healthy expansion of city limits and a refutal of the doctrine of Malthus—"that those who press upon the confines of civilization must die."

By means of the electric road with its all-embracing network of lines, its cheapness of fare and the comparative frequency with which cars pass all points in transit, whether in the city or at its borders, new centers are formed, the vast stream of humanity finds new outlets, the problems of life and health are solved, and the old and distressing conditions of poverty and filth, common to the cities of a few decades ago, are giving way to the new order of things; are giving way, in fact, to the immediate influence of cheap and rapid transit by electric cars.

* * *

Polyphase Sub-Stations.

Mr. S. L. Pearce, the city electrical engineer of Manchester, England, has lately prepared a detailed contribution to the literature relating to polyphase sub-stations. The Manchester system has high tension transmission over an extensive suburban area, and has many sub-stations for distributing electricity to the various districts which take its supply; therefore, though Mr. Pearce did not pretend to put forward anything particularly original on the subject, he

was able to deal with the various types of sub-station equipments that had come within his own experience, and to consider some practical points that have arisen in connection with their working. The several considerations which determine the particular type of equipment to be employed are traction or lighting requirements, frequency of the system, and two versus three phase. These considerations were discussed in turn by Mr. Pearce in his paper, which was read at the end of June at the annual convention of the Municipal Electrical Association. The equipment dealt with was of the three-phase type, with terminal voltages of from 5,000 to 10,000. The majority of sub-stations are required for one or other of the following purposes: (1) Traction system. (2) Mixed lighting and traction systems. (3) Direct current lighting and power systems. The conclusions at which Mr. Pearce arrived after his practical experience at Manchester and elsewhere, are that for (1) very strong reasons must exist if the claims of the rotary converter operating at 25 cycles are overlooked. They are at least 5 per cent. more efficient than either of the other equipments; their ability to stand considerable overloads, and the high power factor at which they can be operated, were considered to outweigh all disadvantages which had been pointed out in another part of the paper.

For (2) it was stated that lighting considerations will probably settle the type of equipment, and, for this, synchronous motor generators, operating at 50 cycles, appeared to best fulfill the majority of the conditions required, viz., ease of regulation of direct current pressure, satisfactory parallel running, little or no variations in pressure; in short, they are not so sensitive as rotaries, and they can also be worked at an equally high power factor. Mr. Pearce remarked that it was possible that the disadvantages of the rotary are sometimes exaggerated; their large use in America, and their increasing use in England, pointed to the fact that under special circumstances their adoption might be deemed warranted.

In class (3) perhaps the most difficulty would be experienced in deciding on the respective merits of synchronous versus induction motors. The drawback to the latter is the fact that the current is always a lagging current, and the smaller sizes have a relatively low power-factor. There is also a gain of from 1 to 2 per cent. in the efficiency in favor of the synchronous type, to balance which may be placed the extra complications in switch-gear. For units of 500 kw. and over Mr. Pearce considers that either type may be usefully employed, the increased cost of the induction type being balanced by the increased cost of switch-gear with the synchronous type. For units of less than the above output, a combination of both types has worked with advantage, the leading currents of the one compensating for the lagging currents of the other, while the induction motors provide the necessary means of starting up the sub-station from the high-tension side in the event of failure on the direct current side of the system.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Dr. F. A. C. Perrine and William W. Gamewell, first vice-president and treasurer of the Stanley Electric Company, have resigned, and C. C. Chesney, chief electrical engineer of the Stanley Company, has been chosen first vice-president.

The Lackawanna Railroad Company will soon experiment on its Montclair, N. J., branch with two storage battery cars to be equipped with Edison storage batteries.

Forty members of the Associazione Elettrotecnica Italiana have completed arrangements to attend the Electrical Congress and will arrive in New York about August 25. The delegates of the Italian Government to the Congress will be Prof. Ascoli on behalf of the Ministry of Posts and Telegraphs, and Prof Lombardi, for the Ministry of Public Instruction.

The joint Wireless Telegraph Board, appointed by President Roosevelt, has completed its labors and submitted its report to the President. The statement was made that the report is unanimous but the board refused to give out any statement regarding its conclusions.

Judge Grosscup of Chicago is quoted as expressing the opinion that if an average period can be fairly figured out for the different franchises of the Union Traction Company, such a plan might furnish the key to the whole difficulty now existing between the city of Chicago and the company with respect to the franchise question.

Telephone people throughout the country are greatly interested in the suit brought by the minority stockholders of the Kellogg Switchboard & Supply Company of Chicago, and M. G. Kellogg, to declare null and void the sale of the control of the stock to interests identified with the American Telephone & Telegraph Company and the Western Electric Company. The case is now before the Illinois Supreme Court on a writ of error, and the point on which it was taken up involves not only the control of the Kellogg Company, but also the control of all the corporations in Illinois owned by the Bell interests. The case has been appealed to the Appellate Court and has also been taken up on a writ of error to the Illinois Supreme Court. It is expected that a decision will be handed down by the Supreme Court in October.

In a number of Western cities companies are being incorporated to operate automobiles for passenger traffic.

Senator M. E. Lewis, who has been elected chairman of the special commission, named by an act of the New York Legislature, to investigate the various methods of canal towing, has appointed a committee to report a plan of procedure. The sub-committee will report a programme to be followed at the next meeting of the commission a week hence. The inquiry will be confined to the limits fixed by the amount of the appropriation and at the same time all promising devices will be investigated thoroughly.

Prof. Geitel, of Wolfenbuttel, Germany, has just been successful, it is reported, in discovering comparatively large quantities of radium in the thermal mud used during the last few years at Baden-Baden for medicinal purposes.

The trackless trolley farm is rapidly becoming a feature in the agricultural development of American farm lands. The horse is losing its time-honored place. Machines, electrically operated, are now in vogue, whose efficiency and lightness are the delight of the farmer's heart. Power is obtained from the rivers or waterfalls, or from adjacent power lines. Electric power is cheaper than horse power and represents a paying investment.

A dispatch from London states that the Government will bring in a bill making wireless telegraphy throughout the United Kingdom a Government monopoly. The post office officials are said to have been experimenting with a new system of their own.

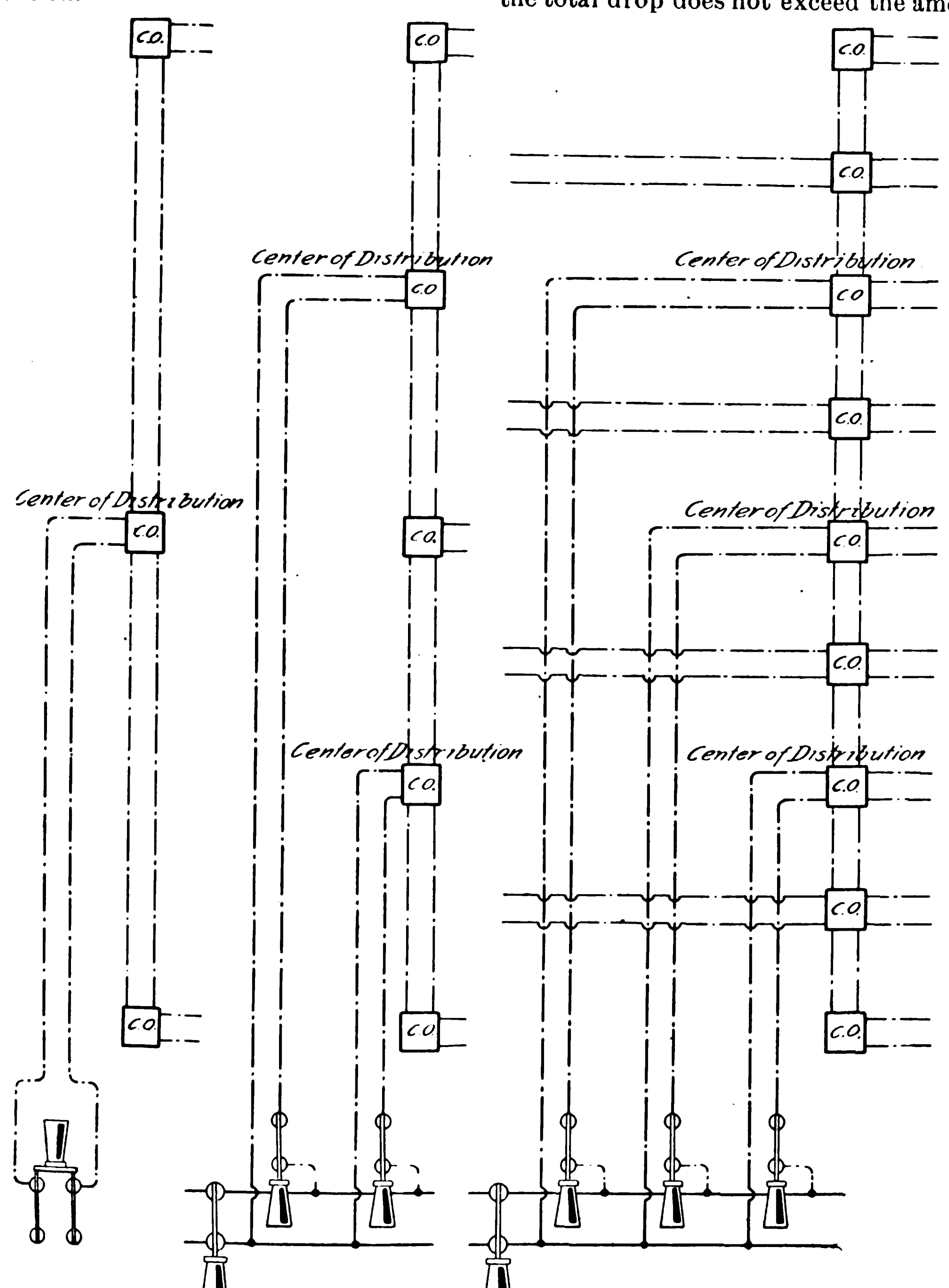
An electric process for peat making is to be installed in a new factory in Eaton Rapids, Mich.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

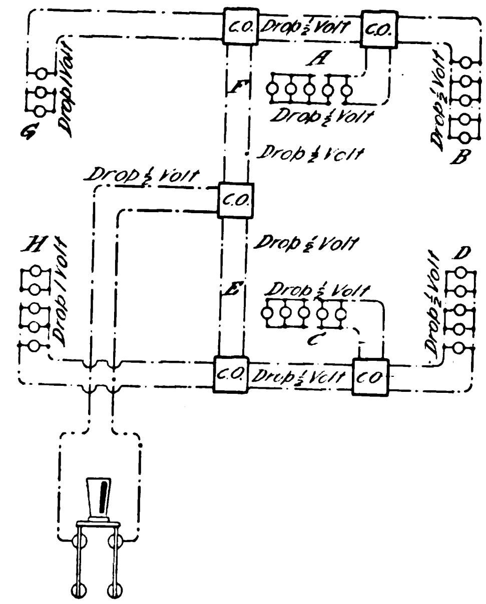
(*Continued from page 19.*)

Equalizing the Pressure.—The choice of centers of distribution is for the purpose, as previously explained, of equalizing the pressure. In house wiring, apartment houses and hotels particularly, differences in the illuminating power of lamps is prohibitive. It is necessary to use many centers of distribution to accomplish this object. In the following sketches may be seen the development of this idea, as illustrated by the case of one, two, three and more centers of distribution.



ONE CENTER OF DISTRIBUTION. TWO CENTERS OF DISTRIBUTION. THREE CENTERS OF DISTRIBUTION.

Sub-centers of Distribution.—The main centers of distribution are of first importance in laying out the wiring system, but then come the second or sub-centers of distribution, which are the means of transmitting the power to the lamps, etc., at approximately the pressure of the main centers of distribution. The same phraseology might be aptly applied with reference to mains, feeders, branches, etc., calling those which perform the same function in a secondary sense, submains, sub-feeders, sub-branches, etc. The problem of distributing the drop in the various elements of such a system in a practical, economical and scientific manner becomes a more difficult task as the various complexities of the system increases. The principle must be rigidly adhered to of calculating the drop for every line and part of the circuit, so that the total drop does not exceed the amount allowed for in the specifications. As a general rule the mistake is made of not estimating the total drop from the source of supply through the circuit to the lamps it ends in as shown by the following simple sketch illustrating this important point in the calculation of wiring:



WIRING DIAGRAM SHOWING THE DROP LIMITED TO TWO VOLTS.

The drop from the source of supply to any group of lamps does not exceed 2 volts, as shown by tracing the circuit from the switch to the center of distribution.

From the switch through E to C = 2 volts.
" " " " F " A " "
" " " " F " B " "
" " " " F " G " "
" " " " E " H " "
" " " " E " D " "

The limit of 2 per cent. need not be observed so carefully in houses or buildings with their own generating plant. In such cases the pressure may drop 4 or 5 volts without any inconvenience on account of the character of the dynamo installed and the extra pressure generated to obviate this difficulty.

Dynamos for Incandescent Lighting.—The class of dynamos employed for incandescent lighting are called shunt wound and compound wound. The shunt wound dynamo can produce a rise or fall in pressure by field regulation. In order to grasp this fact it is necessary to understand the fundamental principle relating to the generation of electro-motive force, which may be popularly expressed in the following words: Electro-motive force is developed by a certain motion of conductors in a magnetic field or a certain motion of lines of force through a conductor. In other words, electro-motive force is developed in a dynamo by motion, magnetism and conductors. A very simple formula expresses the relationship between these elements, based upon the manner in which a volt is generated.

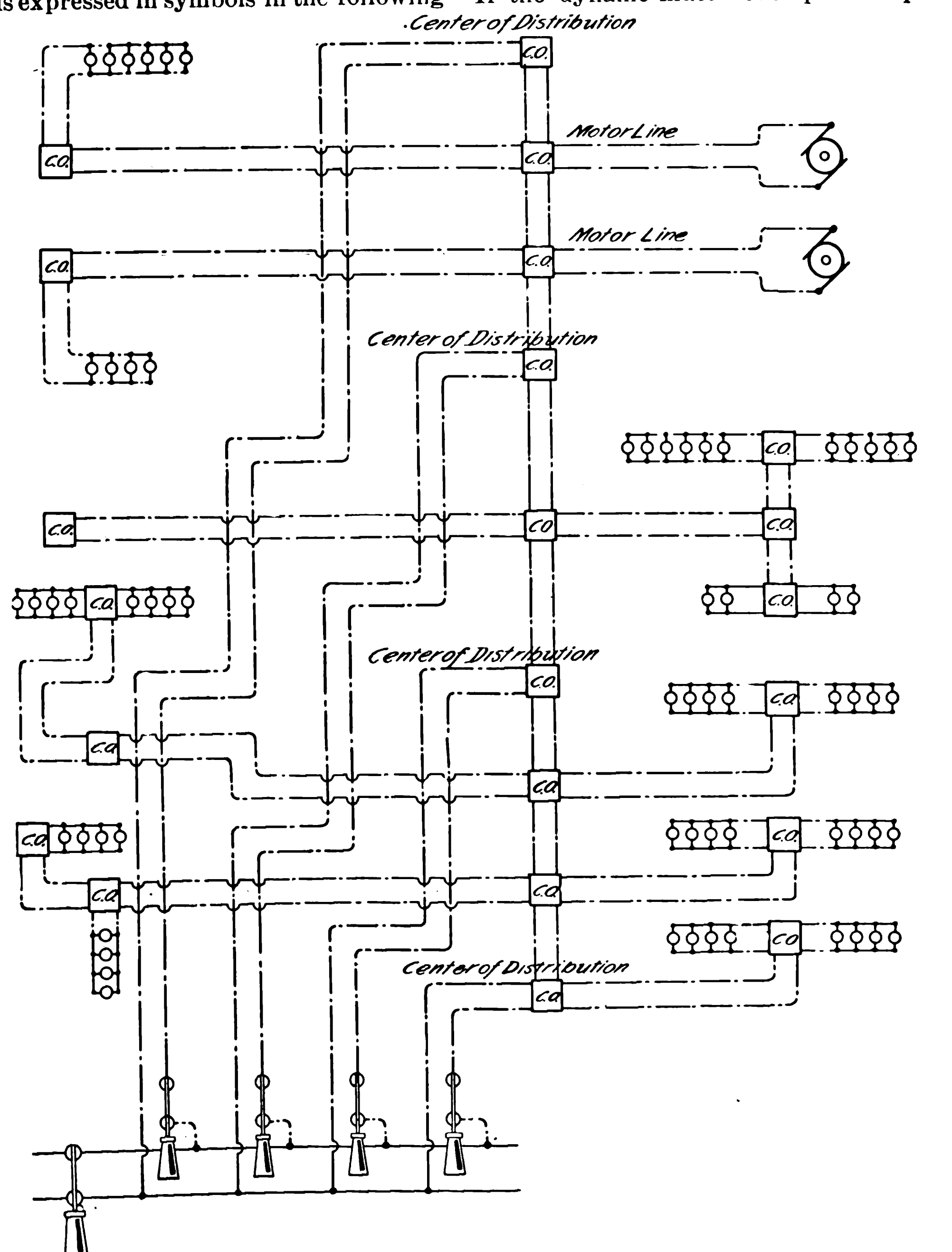
A volt is generated by the cutting of

100 million lines of force in one second. The formula is constructed with the idea of giving the correct answer with any number of conductors, with any degree of motion and with any number of lines of force.

Formula for calculating the EMF. of a dynamo: The electromotive force is equal to the revolutions of the armature per second × the number of conductors on the armature × the number of lines of force passing through the armature, or

$$\text{E.M.F.} = \frac{\text{speed per second} \times \text{lines of force} \times \text{conductors}}{\text{100 million.}}$$

It is expressed in symbols in the following



Four Main Centers of Distribution.

form: $E = N \times c \times n \div 100{,}000{,}000$ where N = lines of force, c = conductors and n = speed per second in revolutions.

The entire purpose of this analysis is to show what a shunt machine is, and how it regulates its pressure, so that its relative importance to the wiring of a building and the lighting may be better understood. The EMF. may be increased or diminished by increasing or diminishing the conductors on the armature, the strength of field or the revolutions per second. As a general rule, the lines of force are increased or diminished to produce corresponding changes in the EMF. This is accomplished by using a device called a resistance box connected in circuit with the winding of the magnets. If the handle of this box is turned one way or the other, the current is controlled, increased or diminished, and thus affects the power of the magnets, strengthening them or weakening them accordingly. If the dynamo must develop more pressure, the magnets are made to develop more magnetism by increasing the current passing through them, or vice versa.

The meaning of this formula is best understood by developing a table showing with what combinations of magnetism, speed and conductors 110 volts can be generated in a dynamo:

Revolutions per second.	Conductors.	Lines of force.	Volts.
100	110	1,000,000	110
50	110	2,000,000	"
50	55	4,000,000	"
25	55	8,000,000	"
12.5	55	16,000,000	"
25	27.5	16,000,000	"
10	55	20,000,000	"

Taking the above figures as a basis for estimating, the EMF. could be held constant while an infinite variety of combinations would be possible in producing the same result. The lines of force are shown to vary from 1,000,000 to 20,000,000, with corresponding changes in the speed and conductors, thus passing from the class of machines called high speed to another class called slow speed generators. If the first line of figures are examined, the speed is indicated as 6,000 revolutions per minute and 110 conductors; to produce 1 volt additional at the same speed additional lines of force equal to 1,000,000 ÷ 110 or 9.091 are required. In other words, any change of pressure taking place in a dynamo, if not produced by a change in the speed or conductors is conveniently produced by a variation in the number of lines of force supplied to the armature.

In the following table the changes in magnetic field required to produce a change of five volts in the pressure are shown with the speed and conductors constant:

Table Showing Changes in Volts Through Changes in Field.

Extra volts.	Revolutions per minute.	Conductors.	Field strength.	Volts.
0	6,000	110	1,000,000	110
1	"	"	1,009,091	111
2	"	"	1,018,182	112
3	"	"	1,027,273	113
4	"	"	1,036,364	114
5	"	"	1,045,455	115

The resistance box connected to the field coils, as above mentioned, will therefore be the means of increasing the dynamos EMF., but not necessarily the pressure it sends out. If the armature of a dynamo is regarded as part of a wiring system it is quite evident that, like any other conductor, an increase of current will mean an increase of drop. This being the case, the dynamo loses its own pressure as it is called upon for more and more current, so that if its original pres-

sure was 110 volts, with only one lamp in circuit its pressure would be considerably lower at one-quarter, one-half and full load. The drop in the armature is not the only influence at work tending to lower the pressure of the dynamo. As the armature carries more current it becomes a stronger and stronger electro-magnet whose action upon the field in which it spins around is destructive. It reduces it systematically and so effectively, that if external means were not employed to compensate for this phenomenon, electric lighting would become a difficult, if not an impossible task on a commercial scale. In shunt wound dynamos the regulation of pressure is accomplished by varying the field in the manner described and this obviates the evil effects of drop in the armature due to its resistance and the current it carries and the magnetic armature reaction which also takes place. But to regulate in this manner it is necessary to be in constant attendance upon the dynamo, unless some assurance is made that the changes in load will not take place rapidly, or unless the dynamo is of immense proportions and its armature, therefore, of such low resistance, that an increase of hundreds of amperes must occur before any severe drop is felt. Regulation of pressure can be carried out practically and automatically by means of automatic dynamos called compound wound dynamos. These machines are so constructed, particularly their winding, that when the two losses, of drop and armature reaction takes place, the dynamo automatically increases its own strength of field without the aid of any resistance box. A treatise on wiring is hardly the place to go into the technical features of dynamo construction, except so far as they relate to the main point, the wiring problem; but it is evident that the wiring problem is to a large extent the problem of electric lighting, and this in itself calls for a thorough understanding of the differences in purpose of construction and operation of the generators employed. In the compound wound dynamos, to briefly conclude this explanation, the regulation is automatically accomplished by sending the main current around the field coils so that as this current increases or diminishes the strength of the magnets it circulates around, will also increase or diminish, and consequently the dynamos will produce more volts only when the armature produces more current.

It is of the utmost importance to remember that the shunt wound and compound wound dynamos are used for central station, street railway and private plants all over the United States for the generation of direct current. Many changes have taken place, so that the above statement does not hold true for all cases, or for the most modern plants. It does hold true, however, for such plants as are installed in public buildings, hotels, apartment houses, etc. The large station of the Edison Company at Pearl and Elm streets, New York, has several big generators, shunt wound, with resistance boxes in use for regulation in operation there.

The wiring of buildings calls for a consideration of the above facts so that provision can be made in the distribution of the drop for the higher and lower pressure in the upper and lower parts of it. For instance, if a 110 volt generator is installed, of the automatic type, and it is over compounded, this means that it may produce 115 volts at one-quarter or one-half load, and then fall slightly as the load increases to 112 volts or a trifle more or less. In this case, considerable drop can be provided for in the wiring of the lower half of the building, Where provision is ordinarily made for a drop limited to two volts, at least twice that drop can now be experienced with a corresponding saving in copper in wiring the lower part of the structure.

The resistances of the various mains, feeders and branches must be carefully calculated in consequence of this in order that the drop takes place, otherwise the lamps will deteriorate rapidly through excess pressure. Incandescent lamps are built to give a certain candle power with a certain terminal pressure applied. If this pressure is too great the current increases to such a point that the life of the lamp is endangered by the overheating of the filament. The filament *loses* its resistance as it is heated. A 16 cp. 110 volt lamp cold has a resistance of about 450 ohms; when it is incandescent its resistance is about 225 ohms. As the filament is heated more and more its resistance becomes greatly reduced and five or ten more volts than the lamp is supposed to take greatly increases the current, the temperature and the light, and cuts down the period of usefulness. About 600 or 700 hours, represents the effective light-giving period. It may, of course, be made to last much longer by keeping the pressure down below its proper value, but while the life of the lamp is increased the cost of the light produced in this manner is very heavy as compared with the cost at the correct pressure. A few figures will illustrate this point clearly. If it costs $5,000 a year to produce 50,000 cp. in a building, including wages, depreciation of machinery, coal, etc., and the engineer tries to save the lamps by running the pressure low, he probably cuts down the light 25 per cent. although full candle power is paid for. He saves an annual expense for new lamps of about $600, but throws away, so to speak, $1,250 worth of light. Lighting under these circumstances is a failure, giving no satisfaction for the money invested and represents the worst phase of false economy.

ELECTRICAL SIGNALING ON RAILWAYS.*

At the present time there are four methods in use for signaling on railways. The first, which is the one more generally adopted, is by means of the semaphore arm, this may be called the universal system for use in the daytime. In the second place, there is the method of adopting various colored lights; this is generally used in connection with the semaphore arm, and is the method adopted for use during the night. For emergency purposes flags are used, while during foggy weather recourse must be had to explosive signals placed on the track, and operated by the wheels of the engine passing over them.

It will be noted that all these signals are used on the track, and not on the engine itself, and so far practice has shown that this is the best position in which to place the signals as they can generally be seen by the signalman, and any defective working is at once apparent. The flagging system is only for occasional use. Leaving this method out of consideration, it may be stated that the method of using semaphore arms in the daytime, and colored lights on the same posts as carry the semaphore arms during the night, gives every satisfaction, and that this system, combined with an interlocking of the various signals and points, insures a high degree of safety.

It is a well-known fact that long-distance trains will maintain with this system an average speed, including stoppages, of 50 or more miles an hour, and will run into the terminal station punctually to time.

Let there be a fog, however, and the conditions are at once changed, although the fog may be of the slight character that is frequently known as a railway fog, by which is meant a fog that only affects railway work; now, instead of this high degree of excellency as regards punctuality, there is a general delay throughout the entire railway system; not only are the main line trains late, but

*From the "Electrical Review," London

the local traffic is entirely disorganized, and it is not at all unusual to find that an hour is taken to do a journey which customarily occupies 10 minutes only. If this is the result in connection with passenger traffic, it is easy to imagine what is the effect on the goods traffic; the trains are held up on all stations. So long as the railway companies rely upon signals placed along the track, and not upon the engine, this state of affairs must be maintained during foggy weather, for even their strongest adherent will not claim that the use of fog signals of the detonating class is conducive to high speed or to punctuality. Whether their use tends to insure safety is also doubtful.

In order to improve the signaling arrangements without interfering with the existing semaphore system, but rather by adding a useful adjunct to it, which acts in conjunction with it in clear weather, and only supersedes it in foggy weather, Mr. Jan Voet, of Haarlem, has devised a means of repeating all signals on the engine. The method which he has

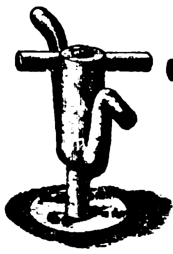


FIG. 1.

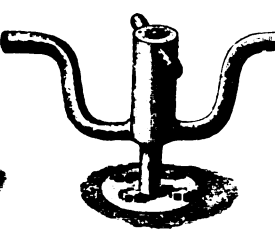


FIG. 2.

adopted is simple, inexpensive, and free from any complicated parts. There is practically nothing to get out of order, while at the same time all the essential features that go to make the success of any signaling system have been kept well in view. Electricity plays a useful role in his system, but is so utilized that there can be no failure which would lead to an accident due to a stoppage in the supply or the breaking of any wire. The description of Mr. Voet's apparatus is as follows:

Between the metals along which the train travels he places a specially-formed piece of metal illustrated in Fig. 1. It will be noted that this metal piece is formed at the top in the shape of a cross, but is so arranged that the two cross-arms do not spring from the same point in the upright, but one-half of the cross springs from the bottom, and is bent so that there is a clear space of some inches between the pillar and top bends of this cross piece. In Fig. 2 is shown the same piece of apparatus, with the arms rotated through a right angle. This piece of apparatus is connected to the wire or rod operating the semaphore arm of the ordinary signal as shown in Fig. 5. The whole is so arranged that when the semaphore arm is against the train the cross-piece is set with the long arms at right angles to the direction of the rails, but when the semaphore is lowered so as to show a clear passage along the section,

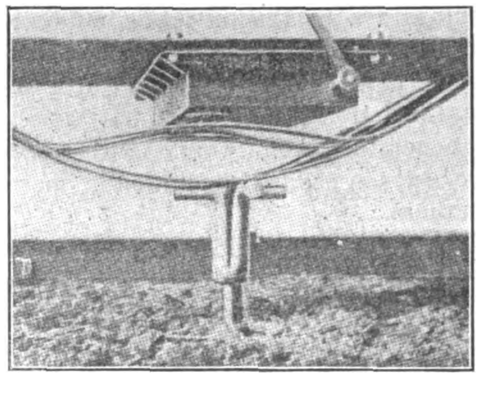


FIG. 3.

the same movement of the signal lever operates the cross-piece, and sets it with the long arms parallel to the rails. Thus, when the cross-piece has its long arms at right angles to the rails, this piece of the apparatus is in the danger position, and will indicate a stop signal to the driver on the engine. In the event of a connection between the semaphore signal and the auxiliary signal breaking, or other accident occurring, the cross-piece will set itself automatically in the danger position, being thrown into this position by a spiral spring, clearly shown in Fig. 6.

On some convenient part of the base of the engine or tender is fixed the apparatus shown in Figs. 3 and 4. This consists of an electrical contact equipment of four copper spring pieces, shown in elevation in Fig. 3, and in plan in Fig. 4. In the latter figure one copper strip is removed, so that the method of attachment may be shown.

The method of working is as follows: On the engine are mounted a couple of portable accumulators, and the circuit

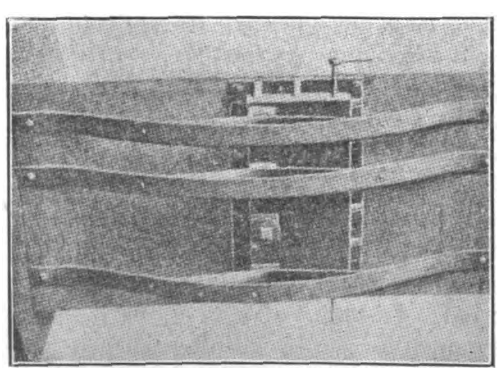


FIG. 4.

can only be closed through the two outer, or through the two inner, of the copper strips on the base of the engine. The cross-piece already described is so arranged, that when this auxiliary signal is set in the danger position, the circuit is closed through the two outer strips only, the distance between the inner bends of the longer cross-arms and the pillar being sufficient to allow of the inner strips clearing them. In the event of the signal being set in the open position, the circuit is completed through the two inner strips, the shorter cross-arms being made sufficiently short to permit of the outer strips passing clear.

It will be noted that in either case a circuit is closed, so that an indication will be given on the engine of the position of the signal, whether up or down. This constitutes its great difference from the detonating signal for foggy weather, which only indicates when the section is closed, and not when it is open. On the engine are mounted two electric bells and two sets of lamps, one a green set and the other a red set. Immediately the circuit is closed through the contact strips, one bell rings continuously, and at the same time one set of lamps becomes incandescent; if the signal is open the green lamps glow, if the signal is at danger the red

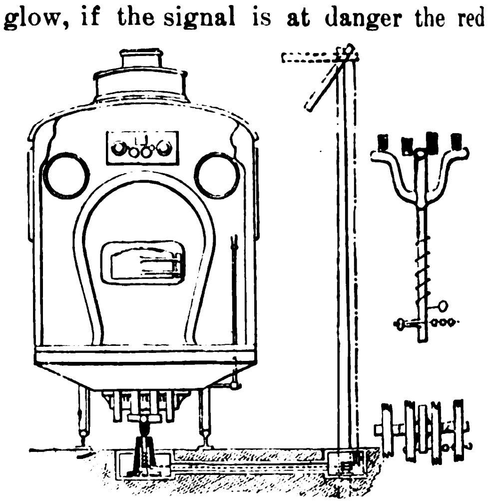


FIG. 5. FIG. 6.

lamps glow These lamps can be arranged in parallel for extra safety, and, if necessary, a green or red disk can be shown on the head lamp lights. The lamps continue to glow and the bell to ring until the engine driver has moved a lever which interrupts the circuit, the arrangement being similar to that adopted in what are known as continuous ringing bells. In Fig. 3 the copper strips are shown making contact through the outer set, the signal being set for the danger position. Fig. 5 represents an engine passing over a clear signal, and shows the relative position of the auxiliary and main semaphore signal. This figure also shows the arrangement of the bells and lamps on the engine. A further piece of apparatus is included in the patent specification, and consists of an indicator not under the control of the driver, which shows how many signals have been

crossed in the clear position, and how many signals in any journey were set against the train.

Mr. Jan Voet claims that this invention of his fulfills all the requirements of any signaling apparatus, and even under ordinary working conditions is a valuable auxiliary to the existing semaphore signals, while in foggy weather it is an essential appliance, if punctual running, combined with safety, is desired.

It will be noted that electricity plays an important role in this design, but that there is no chance of anything going wrong through its use; should the connections between the signals break, it has been shown that the auxiliary signal will automatically set itself in the danger position and the train will simply be brought to a standstill, as is the case should the semaphore signal break down as at present arranged. The inventor claims that by the use of primary or secondary cells in place of generating a current on the engine by a dynamo, a greater degree of safety is insured. Again, the fact that all the signals are indicated on the engine, and not the danger signals only, secures a still greater amount of safety. The driver knows where his signals are, and also knows that each must be repeated on the engine; if then he runs past a signal without any indication being made on the engine, he knows at once that something is out of order, and immediate attention can be given. There have been cases where accidents have occurred which are alleged to be due to the driver overrunning his signals through color blindness; this is prevented in this system, first, by the positions of the red and green incandescent lamps on the engine being different, and, secondly, by the ringing of two differently toned bells, one for danger and one for safety. Further, it is well known that the signals must be set so that the driver can, in most cases, see them long before he reaches them, but in this system the auxiliary signals can be set at any desired distance in front of the semaphore signals. When the line is carried through a cutting round a curve, it is difficult to find a perfectly satisfactory position for the semaphore signal, but with this new system the difficulty disappears.

Mr. Jan Voet claims that the cost of applying this auxiliary system would be small, and little extra running expense would be incurred. It is not suggested that the system is free from objections from the point of view of railway men, but it will be admitted that any device which shows a good prospect of reducing delay within reasonable limits, if combined with safety, deserves consideration, especially if, as in the present instance, the apparatus is inexpensive, and at the same time does not supersede existing methods of working, but is intended to supplement them.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE X.

BY W. H. WAKEMAN.

Although the act of cutting a large hole in a boiler shell weakens it, the use of a well-designed man-hole frame properly attached will strengthen it much, so that it may be practically as strong as a whole plate.

I think that Fig. 23 illustrates about the worst form of man-hole frame and cover that I ever saw or used. The frame is of cast-iron placed on the outside of shell and secured by one row of rivets. The top of frame is turned outward to receive volts as shown, and the cover consisting of a plain slab of cast-iron is bolted to the frame. By adoption of this form, bolts hold the entire strain caused by steam acting on the surface exposed to pressure.

It is only just to say that I have never known of the failure of a cover so made and applied, still it does not appear right, and the principle involved is undoubtedly wrong, as the cover should be on the inside so that pressure will not act directly on bolts, and the packing will be held

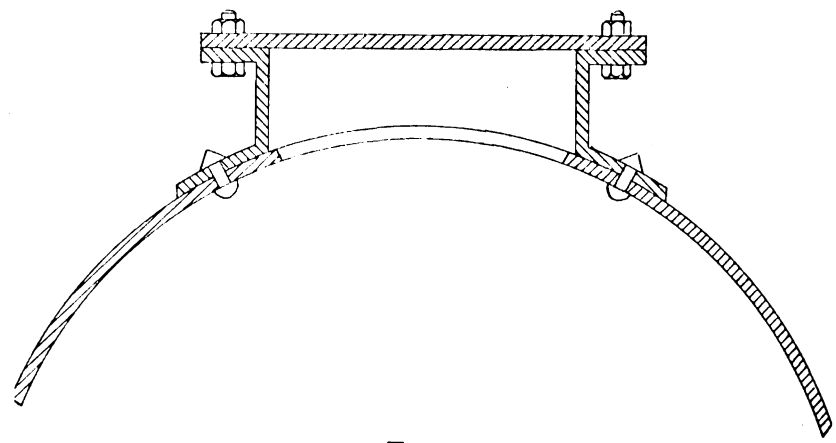


Fig. 23.

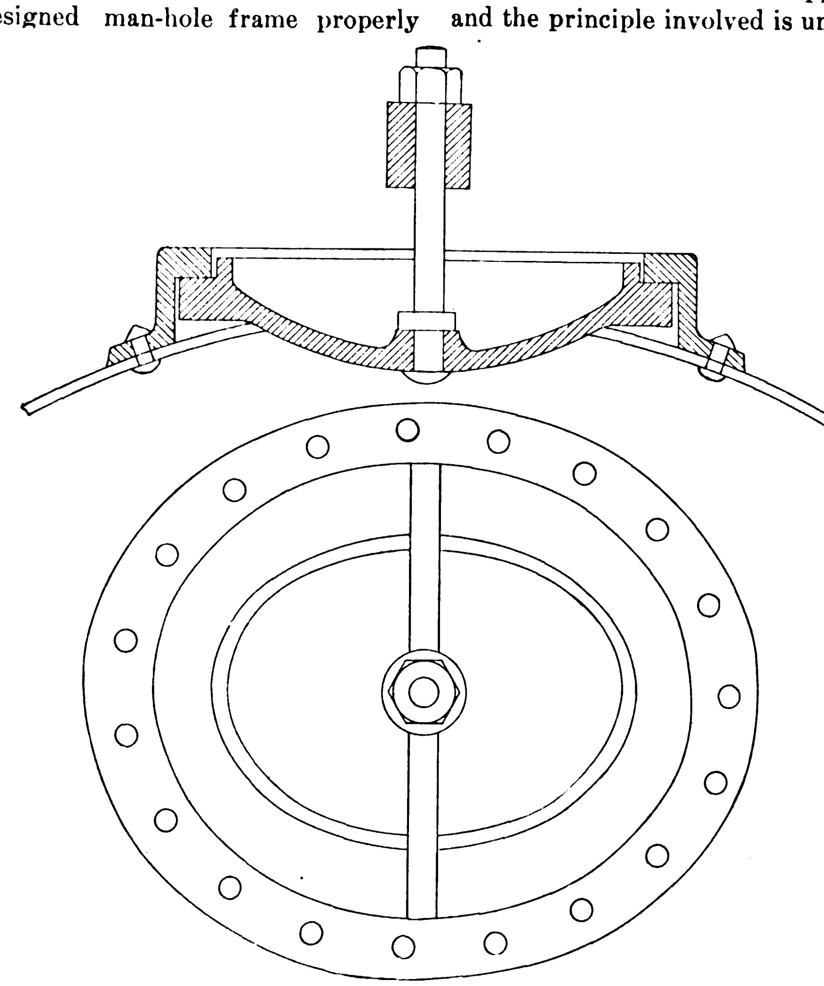


Fig. 24.

tighter as the pressure is increased. Fig. 24 gives the elevation and plan of a man-hole frame that is riveted on the outside of shell, with cover on the inside of frame. These frames were formerly made of cast-iron, but inasmuch as they had to be thick in places in order to match the curve of shell, their strength was a very uncertain quantity, because there was a chance for air holes and other defects to greatly reduce it, while to outward appearances it is very strong.

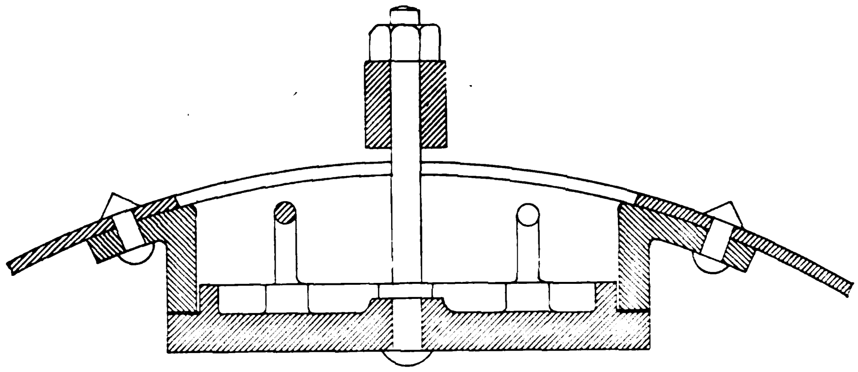


FIG. 25.

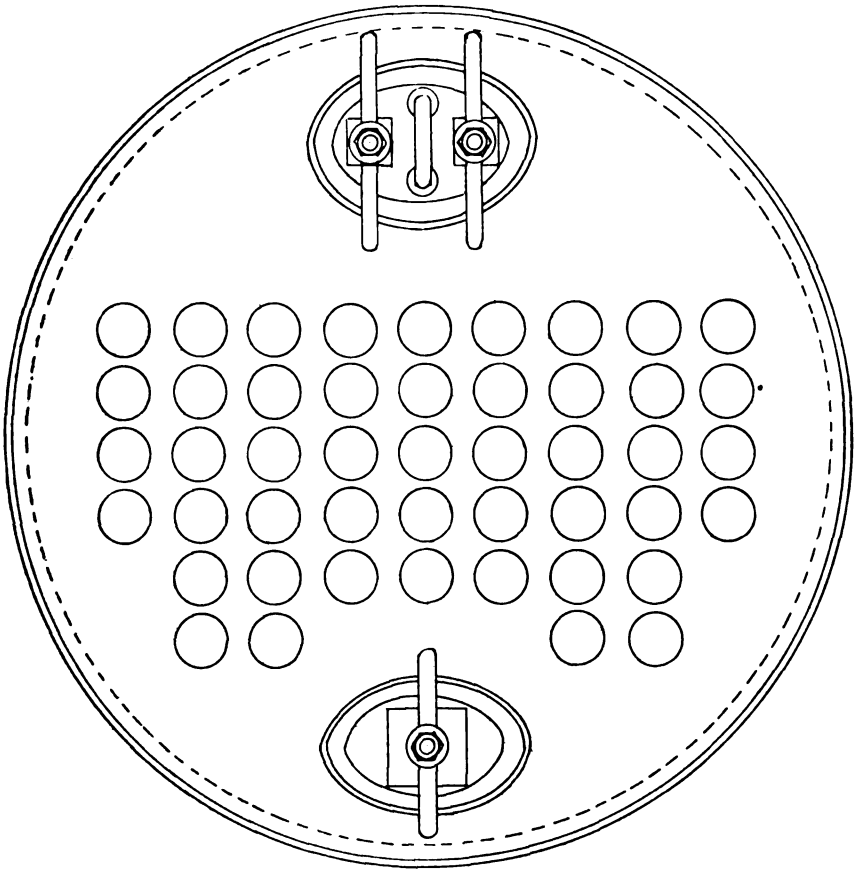


FIG. 26.

To overcome this objection, pressed steel frames are now used, that are lighter, stronger and less liable to contain hidden defects.

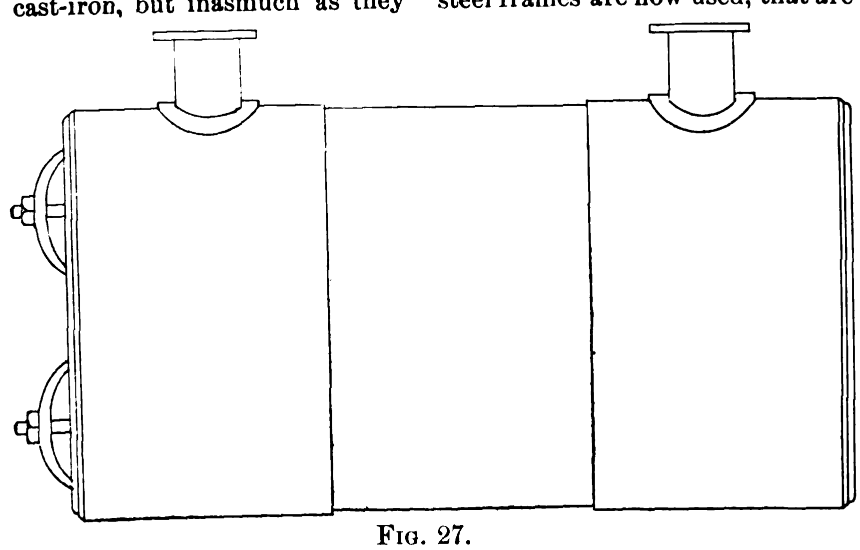


FIG. 27.

The frame shown in Fig. 25 is another improvement, as it is located on the inside of shell. If a man-hole frame like Fig. 24 is carefully examined, and the strain to which it is subjected intelligently noted, it will be seen that the weaker part of frame is found where the greater strain comes, owing to its design, and not on account of the good or bad qualities of the metal composing it. On the other hand, the frame shown in Fig. 25 represents its thicker part to the greater strain, hence is a superior form of construction.

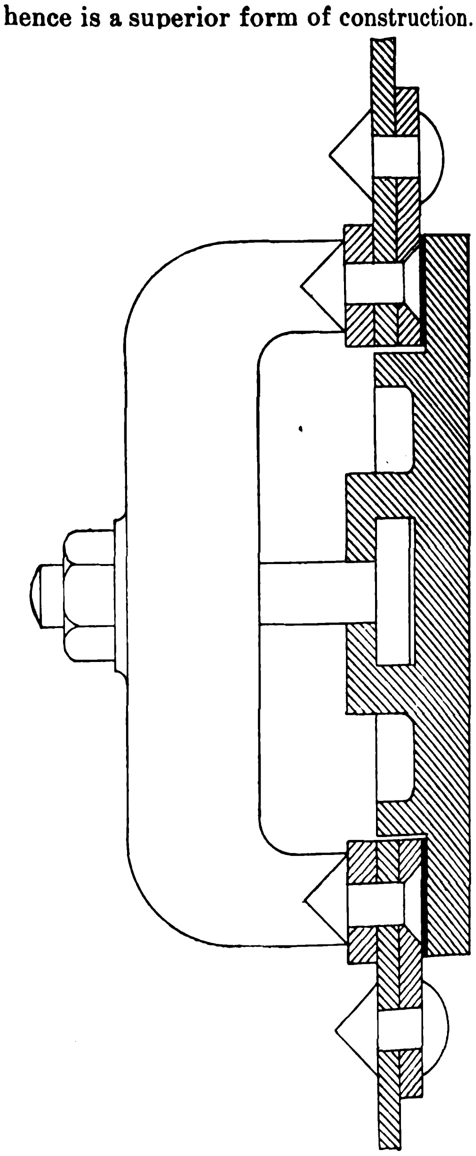


FIG. 28.

The bridges used to span the man-holes and support the cover are made of pressed steel instead of cast-iron, and as it is possible to make them hollow, they are very much lighter. This does not especially affect the strength of shell, but is a great convenience to the engineer in charge, or whoever cleans the boilers.

Fig. 26 shows the head of a tubular boiler with a man-hole below and another above the tubes. This design makes it unnecessary to cut a large hole in the shell for any purpose, as only holes for the steam nozzles are needed as shown in Fig. 27.

If a boiler is carefully and intelligently

constructed according to this design, 4 might be used as a factor of safety and still be as safe as if 5 was adopted when calculating the safe working pressure of a shell in which one or two large holes have been cut, to which defective frames are added, making them appear strong.

The rule for determining when a frame, or a stiffening ring is strong enough to offset weakness caused by cutting the hole, informs us that said ring must contain metal enough to provide an area of cross-section equal to that removed in making the hole. This rule is not always practical, yet it is based on a safe principle.

Fig. 28 illustrates a man-hole with its cover, located in the head of boiler. A wide stiffening ring is used here, fastened by two rows of rivets. Heads of the inner row are countersunk so as to be out of the way. The cross-section of ring shown equals the cross-section of metal removed in cutting the hole, provided all rivet holes are omitted from the calculation, but these make it necessary to bore out a considerable material, making the reinforcing ring weaker than an equal section of the solid plate.

While the rule on this subject is based on a safe principle, as before mentioned, it may call for a larger ring than is actually necessary, for in the case of Fig. 28 the strength of this ring after boring for the rivets may equal the strength of riveted joint in the shell, which is all that should be required.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

REDUCING TRANSFORMER CORE LOSSES

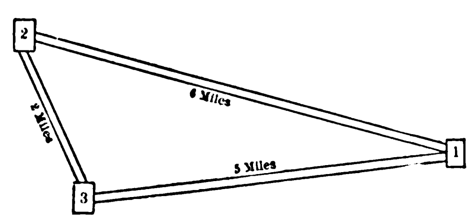
It occurs to me that a description of the method that we have adopted in reducing some of our core losses might be of interest. Our plant is located midway between the business and residence portion of our city and was at one time operated on the Edison underground three-wire system, although the bulk of our business is now handled on 2,300-volt alternating current system. There is considerable lighting in the immediate vicinity of our station, which was supplied by a number of moderate-sized transformers through three-wire overhead secondaries. A small amount of overhead wiring was thought sufficient to incorporate all of these secondaries, as well as the underground supply, into one system, which is now supplied by four 20 kw. transformers located in our station. As the load on these is light during the greater portion of the day, we have arranged so that all but one is cut out during about 18 hours of the day, thus saving the core losses on these as well as on the number of small ones that were displaced by them. It may be that some stations are so located that they could take advantage of this method.

E. J. RICHARDS, Newburgh, N. Y.

THREE INDIVIDUAL PROPERTIES INTERCONNECTED AND GENERAL ARRANGEMENT TO INSURE GOOD SERVICE.

In reply to your last appeal for information regarding our system we beg to state that, aside from the occasional blowing of a fuse in the premises of some customer, we have no trouble to report during the past 12 months. All our mains are underground, and by using the best materials in the market we have escaped burn-outs, etc What lines are overhead are inspected often enough to keep things in shape, and we keep the manholes free from water, etc., by frequent examinations.

We have three power-houses, two operated by water-power and one by steam, and they are connected as shown below.



In case of any station trouble, which we have escaped up to date, the lines are so run that we can carry our load from any two of the three stations. Station No. 1 is the main distributing point, and the voltage on the transmission line is 6,000, two-phase, 60 cycle. We step down to 1,200 volts for the lighting circuits, and supply 110 volts to the customers from transformers located at central points.

By using care we prevent transformers from being overloaded without our knowledge and have no transformer trouble to report. The greater portion of our motor work is still on a 500-volt direct-current circuit, but we are gradually introducing the two-phase alternating. Our present motor load is over 1,000 hp., and in the next month we expect to start a customer who has installed 700 hp. in alternating current motors.

All the men employed in the power-houses work on an eight-hour basis, and as they are paid higher wages than any other men in the same business we are never troubled with the "little things" that less able men would overlook long enough to produce trouble.

At the present time the voltage in our lighting circuits is all regulated by hand, and until such time as a good voltage regulator is put upon the market I think we can produce as steady a voltage curve as anybody. We believe in buying the very best of material, and find that it pays in the end. We aim to give all our customers, large and small, good service and courteous treatment, and the complaints we receive are very few.

If we can tell you any more about our systems and methods, we shall be glad to do so.

W. L. MULLIGAN, Springfield, Mass.

TRANSFORMER TESTING SET FOR LINE USE.

The occasional breakdowns of transformers in service, due to lightning or other electrostatic strains, or to normal depreciation of insulation between the primary and secondary coils or between the primary coil and the core of transformers, have resulted almost invariably in very serious, if not fatal, accidents to the unfortunate victim who may have been in the path of the high voltage circuit at the instant of such a breakdown. Such weakness or defect in transformers in service will not in any manner be indicated by interference of service conditions or otherwise, therefore in such cases the trouble is not known or rectified until too late. Transformers that have been tested as all right are installed in service and most frequently are given no further attention, unless unsatisfactory service conditions, or some change in service, make attention necessary.

In order to guard against such accidents, and to take proper precautions to insure the reliability and safety of the transformers, the writer designed a "line-testing outfit," to be used for checking by test connected transformers in service, without the necessity of removing or replacing them from the primary lines.

This transformer-testing outfit consists simply as a choke coil of high resistance, which is secured in a stationary position in its case.

A movable core of soft-iron laminations is so placed as to partially surround this coil.

The terminals of the coil are connected to two single-pole fuse blocks, placed on the outside of the case.

To test a transformer connected on service lines, the method is as follows:

First—Open the circuit on the second ary of the transformer to be tested. This

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

can usually be done by the main switch near the entrance of the building, or by the removal of fuses from the main secondary cut-outs.

Second—The testing set described is then placed at a convenient point to the transformer to be tested, and the free end of one fuse block is connected to one side of the primary supplying the transformer under test, and the free end of the other fuse block is connected to the secondary of the transformer under test. If a "dead" short circuit or cross between primary and secondary coils exists in the transformer under test, it will at once be indicated by blowing of the fuses. If the fuses do not blow, then slowly raise the movable iron core until entirely clear of the coil. If the fuses do not then blow or melt it indicates that the insulation between primary and secondary coils of the transformer under test is all right, having withstood test of normal voltage of the line.

Third—A similar test is then made between one side of primary as connected and the case of the transformer under test.

This completes the test of the transformer in respect to one side of primary to which it is connected.

The connection of the testing outfit is then changed to the other side of the primary supplying transformer under test, and the same procedure as noted in paragraphs second and third is followed out.

The complete test as described requires but a few moments, and can be made with convenience and entire safety, and the results as indicated are absolutely reliable as regards existing breakdown or weakness in insulation between primary and secondary windings, or between the primary winding and the ground, that is, case of transformer.

As a precaution and safeguard against serious accidents and as an insurance of reliability of high-voltage transmitting devices, the line-testing outfit, as described, has been found to be of much practical utility and value.

G. WILBUR HUBLEY, Louisville, Ky.

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A POLE-PULLER.

The wrinkle I submit is a pole puller, constructed on the same principle as is the stake puller used by the tent men with the circus, except that the wheels of the pole puller are made up of a pair of old 20-inch pulleys, mounted on a $2\frac{1}{2}$ inch shaft; the lever is a 6 inch by 6 inch oak stick about 12 feet long, and the short end of the lever is provided with a strong steel hook.

In using the puller, a heavy log chain is given a half hitch about the base of the pole to be pulled, and the hook on the puller is hooked into the chain, then two or three men on the other end of the lever will pull out a 40-foot pole without much trouble.

This scheme can also be used to lower the same pole to the ground when it is out. Be sure to use as wide a face pulley as can be found, and see that the lever is a good stick, for something will happen if the lever breaks when the pole is being lowered.

L. E. WATSON, Kearney, Neb.

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POTENTIAL BOOSTER.

It is sometimes necessary for an electric light company to run out a long circuit to feed a small neighboring town or a few factories, the load on which is at times so heavy as to cause an excessive drop in potential on this particular circuit.

This difficulty can be easily overcome by installing a small standard transformer (the size varying according to the load), with the secondary leads in multiple, or in series with each other, according to the increased voltage desired, and these leads in series with one side of the circuit; the primary winding in shunt across the circuit, as shown by sketch herewith. This

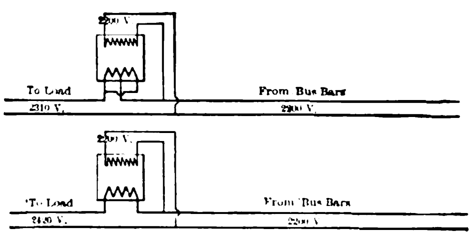

DIAGRAM SHOWING CONNECTIONS.

booster, as it may be called, can be connected permanently in the circuit at the power station, or, by the proper installation of switches, thrown in and out as desired. Should conditions ever change so that the booster is not needed, it can be turned into regular stock.

E. H. MATHER, Portland, Me.

Selection of Architects for United Engineering Building.

The conference committee of the three national engineering societies and of the Engineers' Club, charged with the responsibility of giving effect to the gift of Mr. Andrew Carnegie of $1,500,000 for the erection of two buildings in New York City suitable for their respective purposes, has reached an important stage in its work and made the selection of architects for the respective structures. It was the expressed wish of Mr. Carnegie that the competition should be a mixed one, so that in addition to selecting six competent architects the committee threw the work open to all comers and provided a prize scheme to compensate the best competitors in the open class. Since the middle of June the committee has received 26 complete sets of competitive plans, for the two buildings inclusive, comprising over 500 drawings, and with the assistance of Prof. W. R. Ware, an expert adviser, has spent a good deal of time in the consideration of these designs, all of which, of course, were submitted anonymously. The conclusions now reached are unanimous and are approved by the professional adviser. The successful competitor for the United Engineering Building is Mr. Herbert D. Hale of Boston, with Henry G. Morse of New York as associate architect. Mr. Hale is a grandson of Edward Everett Hale and has done a large amount of public architecture in New England and has constructed some Carnegie libraries, besides doing a very considerable amount of work for the New York Shipbuilding Company. The successful competitors for the Engineers' Club are Whitfield & King of New York, who have done a large amount of work in New York City and on various Carnegie libraries, and were also associated in work on the buildings of the Pan-American Exposition. The designs of this firm were also among those favorably considered for the United Engineering Building, awarded to Mr. Hale. The successful competitors in the open class for four equal prizes of $400 each, in addition to Mr. Hale, are Trowbridge & Livingston of New York, Frank C. Roberts & Co. with Edward V. Seeler, associate, Philadelphia, and Allen & Collins of Boston. It is interesting to note that a very large proportion of the competitive designs came from Boston and that the largest prize, namely, the award for the United Engineering Building, as well as one of the smaller money prizes, has gone to that city.

Details have already been made public as to the nature of the two buildings, which will require for construction from $1,100,000 to $1,200,000. The United Engineering Building will occupy land 125 feet front by 100 feet on West 39th street, while the Club with a frontage of 50 feet and a depth of 100 feet, will face on Bryant Park and the new Public Library. The United Engineering Building, aside from quarters for the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers, as well as other societies enabled to participate in the accommodations, will have several fine auditoriums and a magnificent library. The

Club building will be about 11½ stories high with the usual accommodations of a club and some 60 or 70 bedrooms for members. The work of tearing down the old buildings and the construction of the new is to be pushed vigorously and will begin forthwith.

ELECTRIC LIGHTING OF LADYSMITH.

Ladysmith, like many other towns in South Africa, has shown its ambition to be "up to date," by installing a municipal electric lighting plant, which has been in successful operation for the past eight months.

Being at one time merely a garrison town, and center for Northern Natal, it was but little known to the electrical world; but such cannot be said of it now. Its population at the last returns was 2,273 white, and 3,048 colored.

The power station buildings are of wood and iron, and consist of boiler and engine room, with test room, office and quarters adjoining; the station is conveniently situated near the center of the supply.

The boiler room is 40 ft. long, 35 ft. 6 in. wide, and at present there are installed three boilers of the semi-fixed locotype, each capable of evaporating 2,475 lbs. of water per hour at 145 lbs. steam pressure, the fire-boxes being of special design to suit Natal coal.

A raised tank is supplied with water from the town mains, and delivers water under a small head to the feed pumps, etc.

The feed water is delivered to the boilers by a compound double ram pump, and also by an injector working with the exhaust steam from the engines, and live steam from the boilers.

The engine room is 40 ft. long, 27 ft. 2 in. wide, and is spanned by a two-ton traveling hand crane. At present there are two sets of steam dynamos, each giving an output of 50 kw., at a speed of 460 r.p.m., and capable of doing 20 per cent. overload.—*Electrician, London.*

Good Ventilation.

From actual tests made during one of the hot days last week, it was shown that during the daylight period the temperature of the interior of the Proctor theatres was from 12 to 15 degrees lower than the theometric readings outside in the shade. This result is attained not through the use of iced air currents, so provocative of summer colds, but through an intelligent application of natural principles. The Proctor theatres are all open on three sides, and the natural ventilation aided by electric fans, keeps the air in constant motion, and renders the Proctor houses among the most comfortable places in New York. The fact that these houses are always very comfortable is now very generally appreciated, and even the summer resorts do not tempt the regular patrons from their weekly attendance. The various theatres are generously filled, and the bills offered in the summer are of the same quality as those brought forward in the regular season. There is no cheapening of the programmes in the summer; on the contrary, in the past couple of months more important engagements have been played in the Proctor houses than in other days would have been considered necessary for an entire season.

Proposals Invited.

The Secretary of the Treasury is inviting sealed proposals until July 28 for supplying electric current for lighting and power purposes in the new United States court house and postoffice at Indianapolis, Ind., and for complete heating service, or lighting and heating service combined. Information as to the requirements can be obtained of the superintendent of construction at the building or on application to the Treasury Department, Washington.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 12, 1904.

Electric Railways and Appliances.

764,688. Trolley. George E. Smith Exeter, N. H. Filed June 5, 1903.

764,692-764,780. Overhead Trolley and Trolley for Overhead Tracks. William J. Sumner, Holyoke, Mass., assignor to the Coburn Trolley Track Manufacturing Company, Willimansett, Mass. Filed Feb. 6, 1904.

764,781. Switch for Overhead-Trolley Tracks. William J. Sumner, Holyoke, Mass., assignor to the Coburn Trolley Track Manufacturing Company, Willimansett, Mass. Filed Feb. 6, 1904.

764,807. Trolley-Retractor. Richard H. Ham, Stockport, N. Y. Filed Sept. 29, 1903.

764,856. Electric Railway. Timothy Mahoney, San Francisco, Cal. Filed Aug. 4, 1903.

764,915. Trolley-Guard. Anton Christensen, Chicago, Ill. Filed April 29, 1904.

764,939. Overhead Track for Trolleys. Alvin J. Glor and William P. West, Varysburg, N. Y., assignors to themselves and Robert M. Glor, same place. Filed April 7, 1904.

764,942. Electric-Railway System. Wilbur E. Guthrie, Chambersburg, Pa. Filed Feb. 5, 1904.

765,003-765,004. Trolley-Pole Head. John E. Greenwood, Utica, N. Y. Filed Aug. 29. 1903

765,041. Car-Fender. William H. Reece, St. Louis, Mo. Filed Dec. 1, 1903.

765,067. Street-Car Fender. Jacob Derx, St. Louis, Mo. Filed Jan. 29, 1904.

765,075. Trolley-Harp. Charles L. Hooper, Rochester, N. Y. Filed Dec. 15, 1903.

765,136. Overhead-Conductor-Point-Operating Mechanism. Charles G. Goord, Brighton, Eng. Original application filed May 8, 1903. Divided and this application filed Sept. 17, 1903.

765,137. Trolley-Fork. Charles G. Hartman, Glens Falls, N. Y., assignor of one-half to Edward Ball, same place. Filed Dec. 21, 1903.

Electric Lights and Appliances.

764,792. Automatic Electric Light for Telephone-Booths. John L. Bolan, South Connellsville, Pa. Filed Aug. 23, 1902.

764,844. Machine for Making Incandescent-Electric-Lamp Bulbs. Harvey W. Harper, East Orange, N. J., assignor to the Howard Miniature Lamp Company, New York City. Filed April 30, 1904.

Electrical Machinery and Apparatus.

764,556. Clinometer. Frank T. Cable, New Suffolk, N. Y., assignor to the Electric Boat Company. Filed Feb 4 1903.

764,649. Automatic Motor-Controller. George H. Whittingham, New York City. Filed Oct. 20, 1902.

764,651. Rheostat. Charles Wirt, Philadelphia, Pa. Filed Nov. 6, 1903.

764,814. Electric Measuring Instrument. Arthur A. Kent, Philadelphia, Pa. Filed Nov. 21, 1903.

764,836. Electro Fluid-Pressure Switching Mechanism. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed Aug. 6, 1903.

764,998. Electric Igniter for Gas-Engines. Edgar Ford, Wilmington, Del. Filed Oct. 15, 1903.

765,030. Combined Starter and Regulator for Electric Motors. Edward T. Moore, Newburgh, N. Y. Filed Nov. 10, 1903.

765,032. Magnetic Brake. Jacob F. Mott, Phoenixville, Pa. Filed May 28, 1902.

765,039. Pressure-Controlled Electric Switch. William J. Pugh, Davenport, Ia., assignor, by direct and mesne assigmments to the Automatic Electric Pump Company, same place. Filed Nov. 16, 1903.

765,040. Pressure-Controlled Electric Switch. William J. Pugh, Davenport, Ia., assignor, by direct and mesne assignments, to the Automatic Electric Pump Company, same place. Filed Dec. 24, 1903.

Telephones and Telephone Apparatus.

764,690. Apparatus for Telephone-Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company. Filed Jan. 23. 1903.

764,752. Apparatus for Telephone-Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Oct. 24, 1902.

764,903. Toll-Register for Telephones and an Electrical System for Controlling Same. Harold D. Stroud, Chicago, Ill., assignor to the National Measured Service Company, same place. Filed June 4, 1902.

765,037. Annunciator. Patrick O'Connor, Augusta, Me. Filed Feb. 28, 1903.

765,064. Telephone Desk Set. Peter C. Burns, Chicago, Ill., assignor to the American Electric Telephone Company. Filed March 2, 1903.

765,142. Telephony. Isidor Kitsee, Philadelphia, Pa. Original application filed March 7, 1901. Divided and this application filed Aug. 27, 1903.

Miscellaneous.

764,580. Method of Joining Sections of Underground Conduits for Electric Cables. James M. Graves, Brazil, Ind. Filed June 20, 1903.

764,592. System for the Control of Electric Furnaces. Woolsey M. Johnson, Laharpe, Kan. Filed Nov. 16, 1903.

764,595. Method of Converting the Energy of Fuel into Electrical Energy. Hugo Jone, Chicago, Ill. Filed Nov. 7, 1901.

764,608. Electromagnet. David L. Lindquist, Yonkers, N. Y. Filed March 8, 1904.

764,674. Electrical Heater. Lovell B. Pemberton, Redondo, Cal. Filed Jan. 4, 1904.

764 812. Electrical Insulator. Charles W. Jefferson, Schenectady, N. Y., assignor to the Mica Insulator Company, New York City. Original application filed Aug. 8, 1902. Divided and this application filed Dec. 18, 1902.

764,813. Electric Battery. Pierre J. Kamperdyk, New York City. Filed Dec. 26, 1902.

764,815. Telegraphic Transmitter. William E. Miller Sr., St. Louis, Mo., assignor of two-fifths to Luman M. Strong, same place. Filed Feb. 19, 1904.

764,819. Thermostat. William P. Powers. Chicago, Ill. Filed May 6, 1901.

764,826-827. Galvanic Battery. Charles B. Schoenmehl, Waterbury, Conn., assignor to the Waterbury Battery Company. Filed Nov. 2, 1900, and July 23, 1901.

764,896. Gearing. Hiram P. Maxim, Hartford Conn., assignor to the Electric Vehicle Company, same place. Original application filed June 3, 1896. Divided and this application filed Aug. 29, 1903.

765,060. Storage-Battery. Theodore A. Willard, Cleveland, O., assignor to the Willard Storage Battery Company. Filed Aug. 13, 1903. Renewed June 1, 1904.

765,082. Storage Battery. Isidor Kitsee, Philadelphia, Pa. Filed Aug. 9, 1902.

765,150. Electro-Therapeutic Instrument. James W. Shryock, Pueblo, Col., assignor to Loron E. Wade, same place. Filed Feb. 27, 1904.

THE TELEPHONE WORLD.

Independents Progressing in California.

Among the many counties of the Eureka State, Humboldt is rapidly advancing in the Independent telephone field. The Blake telephone system is one of the many progressive companies which has made the word Independent synonymous with good service and reasonable rates. Included in the territory this system covers are the towns of Arcata, Redwood, Alliance, Glendale, Blue Lake, besides several smaller places through which the lines pass to reach the outlying subscriber. The highest grade of construction and apparatus has been used. J. H. Blake is the owner and operator of this system.

$100,000 For Telephone Improvements in Reading, Pa.

S. E. Wayland, general manager of the Consolidated Telephone Company of Scranton, was recently in Reading, where he said:

"The company proposes spending about $100,000 in improvements in this locality. The lines will be extended to West Reading, North East Reading, Mt. Penn, Birdsboro and Lebanon. The latter lines will take in all of the towns west of this city as far as Lebanon.

"The material for the construction of the lines is now being delivered and the work will be pushed along as rapidly as possible. Superintendent J. F. Taubold will have general charge of the building and equipping of the lines.

"At Birdsboro connection will be made with a new line that is now being built to that point from Lancaster through the Conestoga Valley, taking in all of the towns in Southern Berks."

In speaking of the Reading plant, Mr. Wayland said that he expects to have 4,000 telephones installed there within the next year. The service, he says, is the very best, and generally satisfactory to the public.

The annual meeting of the stockholders of the Home Telephone Company of Jamestown, N. Y., was held recently in that city. A new board of directors for the ensuing year was unanimously elected as follows: Ralph C. Sheldon, Charles W. Herrick, W. J. Maddox, Brewer D. Phillips, S. B. Burchard and T. S. Lane, of Jamestown; and Julius Vautrot, Jr., George B. Devoe, Charles B. Selby, Robert T. Izant and Calvin C. Clawson, of Warren, Ohio. Messrs Shelden, Herrick and Burchard are the new members of the board, all the others having been re-elected. More than 2,400 telephones are in operation. A ssatisfactory financial condition was shown by the statement to the stockholders.

At a recent meeting of the common council of Northfield, Minn., the Tri-State Telephone & Telegraph Company was granted permission to run its line into that city.

The Merchants & Farmers' Telephone Company of Shakopee, Minn., lately filed articles of incorporation with the Secretary of State. The capital stock is $10,000.

The start to secure an underground conduit system for telephone wires in Winona, Minn., has been made by the Northwestern Company.

Another Independent Company for Nebraska.

After long deliberation the Hastings city council unanimously voted to grant a franchise to the Hastings Independent Telephone Company. The original franchise asked for by the company was materially changed before being granted. The 60-year franchise asked for was made to read 30 years, and the city reserves the right to purchase the property of the system after the lapse of 10 years after the installation at an appraised valuation to be determined upon by designated Hastings citizens. The rates agreed upon are $1.50 per month for residences and $2.50 per month for business houses until the new system shall have 600 subscribers, then additional toll of 10 cents per month per 'phone will be charged. Wires in the business portion of the town will be underground.

Retail Druggists Discontinue Bell Service.

In Kansas City, Mo., there is only one telephone in the stores of those druggists who are members of the Retail Druggists' Association, and that 'phone is the one installed by the Home Company.

Several months ago this association decided that the dual 'phone system was a thing to be avoided and that all business could easily be transacted over one system. A committee was appointed to decide which of the two services would be preferable, and reported in favor of the Home Company. The report was almost unanimously adopted, and July 1 was the date agreed upon for the removal of the Bell 'phones.

The local medical association, which includes practically every reputable physician of the city, followed suit and adopted the Home system for the same reasons.

Every member of the druggists' association, when asked about the matter, claims it is simply a business proposition, and considers two systems an extra expense.

The construction crew of the Kansas & Missouri Telephone Company are now in Davis, I. T., building their line from Kansas City to Denison, Tex. They are putting in a line of six copper wires, will establish a transfer station at Davis, where they switch from the Santa Fe Railroad to the Frisco at Sulphur Springs, and will connect with the Southwestern at Denison.

A new telephone line is being erected between Carleton and Stony Creek, Mich., by the People's Telephone Company of Wayne and Monroe Counties. A new line has also been added to the main line out of Flat Rock. Farmers find it a great convenience and many telephones are being placed in farm residences.

A company is being organized to build a telephone line from Childress to Wellington, and Hollis, Tex. The money has been raised and work will be commenced as soon as material can be secured. This line will open up a large territory to the north of Childress.

The Independent Telephone Company is working on its exchange at Clarksville, Tex.

Telephone Valuation Raised in Lincoln, Neb.

The city board of equalization has placed the valuation of the Nebraska Telephone Company plant in Lincoln at $300,000, thereby refusing the request of the concern that its property there be listed at $152,000. The city authorities took the real estate and other property at its actual value, $187,000, and added to it the gross receipts as the value of the franchise, while the company claimed that its estimate of $152,000, represented the total value. According to its calculations the difference between its total and the franchise as shown by the gross receipts represented the actual value of the real estate.

The telephone people will appeal to the district court from the finding of the board. The points raised involve not only the value of the real estate. but also the constitutionality of the section of the new revenue law providing for the taxation of gross receipts of express, telephone and telegraph companies, as franchise values. It is claimed that the provision of the law for the taxation of gross receipts imposes double taxation within the inhibition of section 1, article 9 of the State constitution. The company claims that the value of the tangible property holdings as found by the board is intermingled with the franchise values.

President W. A. Jackson of the Michigan State Telephone Company states that this corporation has nothing to do with a $20,000,000 merger of Bell companies reported from New York to include companies in Michigan, Ohio, Indiana and Illinois.

What is said to be the longest private telephone wire is being erected by the New York Central Railroad. It is 1,000 miles long and is being strung from New York to Chicago. A No. 8 copper wire is used, and it will touch every important city on the line of the New York Central system.

A meeting in the interest of a rural telephone line was lately held in Woodstown, N. J. Representatives of the Gloucester County Rural Line. who are now erecting a line from Swedesboro to Mantua, gave their experience in the formation of a company. About $1,500 has been subscribed in the vicinity of Woodstown.

The stockholders of the Union Telephone Company, whose head offices are located at Alma, Mich., paid the semi-annual dividend of 4 per cent. The capital stock of the company is $400,000, which is represented by over 400 stockholders located in the counties of Gratiot, Montcalm, Isabella, Clare, Washtenaw and Clinton.

Telephone Incorporations.

The Bellair Telephone Company, Bellair, Ill. Capital stock, $5,000. Incorporators: L. M. Biggs, J. C. Farley and E. M. Wiman.

The Clarkfield Telephone Company, Clarkfield, Minn. Capital stock; $3,000. Directors: John Larson, W. B. Torgerson, A. J. Johnson, E. Monsan, J. H. Lynner, J. N. Silver and George J. Piersol.

The Broken Arrow Telephone Company, Broken Arrow, I. T. Capital stock, $5,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bay City, Mich.—Bids are being received for the proposed municipal commercial electric lighting plant to cost $50,000.

Charlevoix, Mich.—The village council here has voted to accept the proposition made by Bellaire men to furnish this village with light and power from a new plant to be erected on the Intermediate River at Bellaire, and a franchise has been given which provides for the completion of the plant by June 1, 1905. It is proposed to build a dam and erect a plant capable of furnishing 1,000 hp. Henry Richards is owner of the power plant at Bellaire.

Columbus, O.—An ordinance to provide for issuing bonds for erecting and completing electric light works in this city has been passed.

Echo, Ore.—The council has under consideration two franchises, one for waterworks and the other for an electric lighting system. They were offered by J. P. Nelson.

Fremont, Neb.—The city council has decided to enlarge the electric light plant.

Gretna, La.—Arrangements for lighting the streets and roadways of McDonoghville and this town by electricity have been made.

Harrisonburg, Va.—The town council has decided to issue $60,000 in bonds for the purpose of installing an electric light plant.

Jasper, Ala.—The Jasper Water, Light & Power Company has been incorporated with a capital stock of $50,000, by J. H. Cranford, L. W. Lollar and others. The company will furnish water, gas and electricity for this city.

Joplin, Mo.—The city council has decided to hold a special election on August 2, for the purpose of voting bonds, to the amount of $30,000, to increase the capacity of the municipal electric light plant.

Lakeville, Conn.—A dam will be built across the Housatonic River near the toll bridge by the Canaan Electric Light Company to furnish power for the lighting system at Canaan.

Lincoln, Neb.—The city council has ratified a contract with Prof. C. R. Richards and G. H. Morse, of the State University, to be consulting engineers for the installation of the new electric lighting system.

Middleville, N. Y.—The Middleville Electric Light Company has been formed to manufacture electricity. Its capital stock is $4,000, and incorporators L. H. Goodman, David E. Ford, and Anna M. Goodman, all of Middleville.

Norwich, Conn.—A $235,000 issue of bonds has been authorized by the common council for a gas and electric light plant.

Pataskala, O.—Al. G. Fields, of Columbus, is at the head of a company that proposed, with proper encouragement, to put in an electric light plant here, that will not only furnish illumination for this place alone, but for Jersey, Summit Station, Etna, Kirkersville and Outville. Such a plant would cost something like $200,000.

Reinbeck, Ia.—The electric light plant here has been sold to Henry Nisson, of Keystone, who will continue its operation.

Richmond, Va.—Mr. Cranshaw will introduce an ordinance into the common council providing for a bond issue of $300,000, the money to be raised by this means to be used in the construction of an electric light and power plant on the site of the old pump house.

Royalton, Minn.—The village council will vote on the proposition of issuing $10,000 bonds for an electric lighting plant.

Sioux Rapids, Ia.—A council committee will secure a price for the purchase of the electric light plant and also the cost of a new plant.

STREET RAILWAYS.

Albany, N. Y.—The Central Hudson Railroad and the General Electric Company will build a third-rail electrical system from Schenectady to Hoffman, to test the electrical locomotives which are to be used on the Hudson River Division of the Central Hudson Railroad, from Grand Central Station to a point about 35 miles up the road. The new road will be about six miles long and will be used expressly for experimenting with the new locomotives. If the test proves successful the electrical locomotives will be put in commission.

Appomattox, Va.—A company has been formed here to construct an electric line from here to Drakes.

Broken Bow, Neb.—F. R. Woodington, William Warren, J. D. Trayer and J. Miller are the principal stockholders and head promoters of the Loup Valley electric road, and have been here surveying.

Galena, Mo.—J. M. Cooper, a prominent merchant of Baxter Springs, states that arrangements are being made to build an electric line from Baxter Springs to this place.

Highland, Ky.—Charles W. Shinder, trustee for the mortgage bondholders of the Highland Railway Company, will in a few days commence work on the reconstruction of the Highland electric line.

Houlton, Me.—The proposal to build an electric road through some of the northern towns of Aroostook County is again revived. E. M. Mather, of Portland, an expert civil engineer and electrician, who made a very recent survey of the proposed electric railroad route, as previously laid out to Washburn, and who also went over the route to the Aroostook Falls, from which source it was proposed to generate the power, has sent in a most favorable report.

Huntington, Ind.—The Portland, Montpelier & Huntington Traction Company has secured a private right of way for the building of its lines.

Jackson, Mich.—After a conference at Terre Haute, Ind., with Chief Engineer Paige in regard to the interurban electric railway between here and Vicksburg, S. P. Barton, secretary of the Mississippi Land & Investment Company of this city, says that the construction of the line is a certainty and the work of laying the rails will be begun before the end of the year, as several well-known capitalists have assured the company of their support.

Kansas City, Mo.—A. F. Hatch and A. V. Overshine, representing the Kansas City & Topeka Railway Company, state that the company proposes building an electric line to Topeka.

Logansport, Ind.—It is rumored that an electric railway line is to be built connecting Warsaw and this city

Marion, Ind.—W. Osgood Orton, of South Bend, who claims to be interested in the Indiana Northern Traction Company, was in the city a short time ago relative to the entrance of the Geneva Electric Railway to the city. The survey of the line has recently been completed from here to Celina, O., a distance of 61 miles.

New Iberia, La.—The Bayou Teche Electric Company, which has for its object the building and operating of an electric railway from here to Berwick, and the supplying of light and power to a large section of country, will be organized at an early date and the construction work begun. The corporation is in the hands of Gen. F. F. Myles, who has large interests in that section, and he says that practically all of the $1,000,000 of capital has been secured, the franchises granted, and the route located, and that plans for other improvements incident to the railway are being prepared.

Omaha, Neb.—Chicago capitalists have organized a company to build and operate the first large interurban electric railway in this State. The corporation will be known as the Omaha & Nebraska Central Electric Railway. It will be 200 miles long, and extend from this city to South Omaha, and in a westerly directions through Millard, Wahoo, David City, Osceola, Stromberg, Arborville, Aurora and Hastings. The road will carry passengers, mail and freight and be constructed of standard gauge.

Papillion, Neb.—The Omaha & Southwestern Electric Railroad Company has secured the right-of-way to extend its lines.

Pontiac, Ill.—The Bloomington-Joliet Interurban Company will construct a trolley line between here and Dwight.

Racine, Wis.—The Racine county board has refused the St. Paul Railroad Company permission to build a side track on the county insane farm. This refusal may mean the building of an electric line from this city to Corliss.

Rhinelander, Wis.—Mayor Matt Stapleton, of this place, is interested in a project to build an electric railway from Eagle River to Merrill.

Wheeling, W. Va.—The Wheeling Traction Company will begin work on the new line which will in a short time extend through the western part of this city.

POWER PLANTS.

Belton, S. C.—The Belton Power Company has been organized with a capital of $100,000. The object is to develop the water powers on Saluda River and to furnish electric power to the mills here and at Williamston and ultimately to furnish water and lights to this town. John B. Adger is president and treasurer: R. A. Lewis, vice-president, and James T. Adger, secretary.

BIDS WANTED.

Chicago, Ill.—Sealed proposals are invited by the board of commissioners of Cook County, for plans and specifications for installing an electrical equipment in the Cook County Court House.

Lexington, Ky.—Bids will be received for the erection of two 35 kw. generators and engines complete; also a 75 kw. generator with slow speed engine, at the Eastern Kentucky Asylum for the Insane in this city, by J. R. Morton, chairman of the board of commissioners.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅝@12¾c.; Lake 12⅝@12⅞c.; casting, 12⅜@12½c.

The Boston Edison Electric Illuminating Company has declared its regular quarterly dividend of 2½ per cent., payable August 1.

The Electric Company of America has declared the regular semi-annual dividend of 3 per cent., payable July 30 to holders of record July 21.

A mortgage for $1,000,000, executed by the Commercial Union Telephone Company to guarantee bonds to the same amount, was filed last Friday at Ballston Spa, N.Y., for record in the clerk's office of Saratoga County.

The Omaha Electric Light & Power Company has declared a semi-annual dividend of $2.50 a share on its preferred stock, payable August 1 to holders of record July 20.

Brooklyn and Boston capitalists have purchased $5,000,000 of the Brooklyn Rapid Transit refunding, convertible 4 per cent. bonds. The convertible clause gives a 10-year option, from July 1, 1904, on Brooklyn Rapid Transit stock at par.

It is said that negotiations will be made soon for the merger of the City and Suburban Company of Portland, Ore., and the Portland Railway Company, the two big competing railway companies, which operate an aggregate of 112 miles of track.

Amalgamated Copper directors meet for dividend action to-morrow, July 21. People who should know the probable action of the directors through close association with them say the regular dividend of ½ of 1 per cent. only will be declared.

A meeting of the directors of the Western Telephone & Telegraph Company was called for Monday at Boston to take action on the semi-annual dividend on the preferred stock, but owing to the impossibility of securing a quorum the meeting was postponed.

The controlling interests in the Syracuse (N. Y.) Rapid Transit Company and the Utica and Mohawk trolley lines have been sold to the Vanderbilts, and these roads will be used as feeders for the New York Central. The Vanderbilts will have 51 per cent. of the stock of the two roads.

Redmond & Co. of 41 Wall street are offering $250,000 Metropolitan Street Railway Company refunding mortgage 4 per cent. gold bonds. The bonds are secured by a direct first mortgage on real estate in New York City. A general mortgage subject to prior lines of the Metropolitan Street Railway Company also secures these bonds.

William Northrop and Henry T. Wickham of Norfolk, Va., were appointed receivers for the Virginia Passenger and Power Company and ordered to take immediate possession of the property. This action was taken at the instance of the Bowling Green Trust Company of New York, trustee of the mortgage, who filed the bill. The property is controlled by Frank J. Gould and is capitalized at $10,000,000.

Judge Lochren, in the United States Circuit Court for Minnesota, has handed down a decision holding that the Twin City Rapid Transit Company has a right to build lines on all streets in St. Paul except a few on which it surrendered the right on the condition that no other company would be allowed to construct lines in those streets. The decision is decidedly in favor of the Twin City Company and permits it to go ahead with the construction of its proposed extensions, which had been held in abeyance while the litigation was pending.

ELECTRIOAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price July 18
New York City.	
Broadway and Seventh Avenue	242
Manhattan Elevated Railway	151¼
Metropolitan Street Railway	116⅞
Metropolitan Securities	87½
Ninth Avenue	195
Third Avenue	122⅛
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	232
Brooklyn Rapid Transit	51
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	67
Philadelphia Traction	96¼
Union Traction, $17.50 paid	53½
Boston.	
Boston Elevated, full paid	141
West End Street, com	90½
do. do. do. pref	110½
Chicago.	
City Railway	168
North Chicago	71
Union Traction, com	4¼
do. do. pref	29½
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	47
do. do. pref	76
Electric Lead Reduction	¾
Electric Vehicle, com	9½
do. do. pref	14
Westinghouse, com	165
do. pref	190
General Electric	165
Boston.	
Edison Electric Illuminating	248
General Electric	164½
Massachusetts Electric Companies, com	19½
do. do. do. pref	73½
Westinghouse Electric & Mfg., com	80
do. do. do. pref	96
Chicago.	
Chicago Edison	145
National Carbon, com	28½
do. do. pref	101½
Philadelphia.	
Electric Company of America	9⅛
Electric Storage Battery, com	59
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	131
Western Telephone Company	9½
New England Telephone Company	121½
New York.	
American Telegraph & Cable Company	86
Commercial Cable Company	180
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88⅜
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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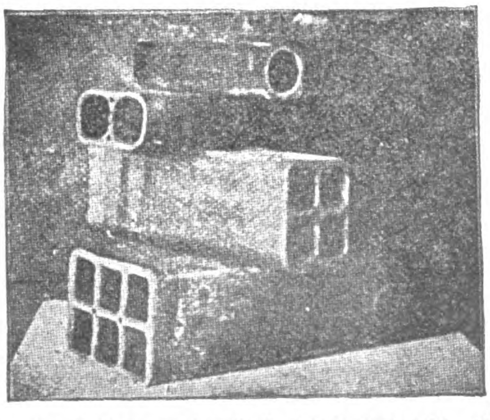

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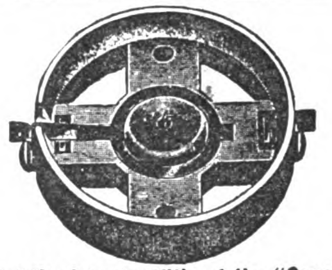

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CONTENTS.

EDITORIAL NOTES.

The Roadbed of High-Speed Electric Roads.

The mandate issued by the English Parliament in the first days of steam roads, that if the enormous speed of twelve miles an hour was attained, a high fence must be built on each side of the track to prevent passengers from being affected with deliriosum furiosum or whirling of the brain, seems historically unique when, at this present writing, speeds of 100 to 150 miles an hour are seriously considered for passenger service, and according to reports no unusual psychological symptoms are in evidence.

The construction and successful operation of high-speed electric roads is in many respects largely dependent upon the character of the roadbed. The roadbed includes not only that which is implied by the term, but the rails as well; and in order to render a test fair and practical, both roadbed and rails must meet those new requirements imposed upon them by the extraordinary conditions of weight and speed embodied in the electric car to be tested.

A series motor running without load will theoretically reach an infinite speed. In practice, however, the existence of friction and air resistance tend to limit the velocity, and the effects of centrifugal force would in any case lead to the complete destruction of the motor if it were allowed to rotate unchecked. There is no practical limitation therefore to the degree of speed in the inherent principle of the motor, and in this respect it is in direct contrast to the steam locomotive. To obtain high speeds, such as are required for cars moving at the rate of 150 miles an hour, the motors must be designed with reference to greater tractive effort in the first place, on account of air pressure, etc., and secondly, full allowance must be made for the varying character of the roadbed over which this swiftly moving mass must travel.

The rails employed, according to experiments tried as far back as ten years ago by Crosby and Bell in this country, are subject to a double strain, the effect of which is to seriously impede the full progress of the electric car. This strain on the rails is of such a character that they are forced inwards, and when the weight of a car falls on the beginning of a rail it is bent into a curve, forming a distinct angle with the horizontal plane. The car, as it were, in this case climbs a succession of inclines, which, it is almost unnecessary to state, call for a much greater development of power to reach a given speed than theory would indicate.

The rails must therefore be rigidly held in place in order to overcome these shortcomings, and to accomplish this the roadbed must be made unusually solid and secure. By the use of heavy rails, designed to resist any temporary malformation and a roadbed which forms with the rails an unyielding body, the greatest difficulty in the construction of high-speed electric roads is removed. The problem then narrows itself down to a question of power and lubrication; which do not seem, in the light of past accomplishments, to constitute impediments.

There is, of course, in this at present purely experimental field much that is unknown to be discovered, but so far as the application of fundamental principles is concerned, the ground has been well covered, the principles have been crystallized and it remains to meet and overcome those details in construction and operation which always threaten the early stages of invention in the inauguration of its purposes and application.

Electrical Undertakings In South Africa.

One of the most important fields opening up for the introduction and extension of the electrical industry in almost all its branches is that of the South African countries, and it is one which is well worthy of being closely watched by American manufacturers and exporters in these particular lines.

A short time since an electric central station was opened at Cape Town. At the opening ceremony attention was called to the abnormal increase in the consumption of electrical energy in Cape Town, where the demands for private lighting purposes have increased to thirty-seven times their original volume, while further growth and prosperity was assured. This showing is not abnormal as applied in general to the industry in South Africa. Indeed, the general adoption of electricity throughout South Africa is one of the most remarkable features of that country's development. It is shown by the success of her electrical enterprises, and still more by their constant expansion; in the growth and installation of street-car and lighting plants in so many centers, and the formation of larger and still more comprehensive schemes, and in the eulogistic opinions expressed by those who have thoroughly studied the situation. All this has been accomplished under what have really constituted most adverse conditions, when all classes of industry were still suffering from the effects of a long and peculiarly destructive war, and the whole country being held back to a great extent by the subsequent unsettled conditions. The growth of the electrical enterprise in the past, great as it has been, is therefore but a poor criterion of the dimensions to which this industry will attain in the future.

In the past South Africa has offered an ample market for all forms of electrical plants, in which the United States has but sparingly participated. The volume of the demand has yet to be met, and it is this which will so richly repay any effort that may be made on the part of American houses to secure same.

Under every head the growth and prosperity of the electrical industry in South Africa is assured. The conditions which obtain have long rendered it almost a necessity for private consumption, while the extension of telegraph and telephone systems will alone materially enhance the demand. Electric traction has already sprung into remarkable prominence. Many are the schemes now under consideration, or already pigeonholed, awaiting only favorable conditions to bring them to fruition. Johannesburg is one of the latest examples in this respect, and it has been stated that next year will see the start of her electric railway system.

It is of the utmost importance that our American manufacturers should fully grasp the position in South Africa, its difficulties as well as its opportunities.

Our strongest competitor in the field is Germany, although many of the largest installations of electrical equipment have been made by American firms. One thing largely in our favor is the fact that the American engineer is very much in evidence in South Africa, and of course his sympathies are with American manufacturers, and it is admitted that his taste for American machinery is as pronounced as his success in installing it in the mines, and it is in this respect that other countries foresee in us very formidable rivals.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Two of the big 8,000 hp. generators, for operating the subway cars in this city, were tested last week, and were found to be equal to their promised capacity. When the power station at West 59th street and 11th avenue is completed it will contain twelve 8,000 hp. generators, and when everything is in working order power enough will be generated, it is claimed, to not only run the subway and elevated systems, but other contemplated subways.

In an attic room of his costly Fifth avenue palace Colonel John Jacob Astor, the possessor of about $100,000,000, spends much of his time while in New York studying and experimenting in electrical science.

A joint stock company with an authorized capital of $482,500 has just been organized at Milan, Italy, for the purpose of utilizing the water power of the Province of Liguria for an electric plant.

A test of the electric "mule" was made in Schenectady, N. Y., last week for the benefit of the Joint Legislative Commission to investigate the matter of electrical towage of canal boats and the enlightment of the Isthmian Canal Commission. The tests were witnessed by William H. Burr, of Columbia College, and a member of the Panama Canal Commission; H. M. Diederich, director of the railways and canals in Germany and technical attache of the German Ambassador to this country; the members of the Advisory Board of the Barge Canal; State Engineer Van Alstyne, and the members of the Legislative Commission. This commission will soon invite inventors and manufacturers to lay before it any plans they may have for the electrical propulsion of boats. The committee inspected the Wood system at Schenectady and seemed to think the system practicable. A sub-committee will be appointed to consider the plans for towing systems. The German Government recently inspected and tested a number of them and found them all to be defective. The report on the tests will be translated by the Legislative Committee and copies printed and distributed. The information contained in the document is said to be valuable.

A site for a general terminal of the Illinois Tunnel Company's system of underground electric railways has been secured by the company at a cost of $2,500,000, through the purchase of the property on the west bank of the Chicago River.

In pursuance of the policy which the New York, New Haven & Hartford Company has pursued since it first purchased the Stamford, (Conn.) Line, of buying competitive electric roads the company has, through the Consolidated Railways Company, purchased the New London Street Railway Company, the Norwich Street Railway Company and the Montville Street Railway Company. Payment was made for these companies in the 50-year 4 per cent. debenture bonds of the Consolidated Companies. The New Haven now owns nearly all the competing lines with the exception of those of the Connecticut Railway & Lighting Company.

According to the *Zeitschrift fur Elektrotechnik*, the Stubaitalbahn, the first single-phase electric railway in Austria, is to be opened during the present month. The line in question is about 12½ miles long, says the London *Electrician*, and has several long gradients of 4.5 per cent. Each train is made up of one motor car, equipped with four 40 hp. to 50 hp. single-phase motors and two trailers. Electric energy at 10,000 volts is supplied from the "Sillwerke" power station.

A company has been formed in Cologne with a capital of $1,750,000, subsidized by the German and Dutch Governments, to lay a cable to connect with the Dutch settlement on the island of Celebes, through the island of Yap, in the Pelews group and from Shanghai to Guam, where it will link with the Commercial Cable Company's Pacific cable.

Foreign Pointers for American Enterprise.

The State Department at Washington makes public the following received from American Consuls:

New South Wales and Victoria, Australia, contemplate the substitution of electric for steam power on their railroads.

An electric plant is to be installed for the railroad freight depot at Brussels, Belgium.

The Government of Tepic, Mexico, will receive bids for the construction of an electric plant.

The near completion of the electrical plants in Bombay, India, will cause a large demand for ventilators and various other appliances.

Harbor improvements (new docks, storage sheds, bridge, electric cranes, etc.,) are to be made at Victoria, State of Espirito Santo, Brazil.

$2,000,000 Contract for the Allis-Chalmers Company.

The big electrical concerns received a shock last week when the news was made public that the Allis-Chalmers Company had secured a contract, through Thomas E. Murray, who acts as consulting engineer for the Brooklyn Rapid Transit Company, the New York Edison Company and other companies in which Anthony N. Brady is a dominant factor, for nearly 100,000 hp. of equipment, which will incur an expenditure of upwards of $2,000,000.

This is the largest contract of its description ever placed in this country. The biggest hitherto let was given to the Westinghouse interests, for three 5,500 kilowatt Westinghouse-Parsons turbo generators, which are to serve as equipment for the new Long Island City power house of the Pennsylvania Railroad. The next most important order was allotted to the General Electric Company, for three 5,000 kilowatt units for the Commonwealth Electric Company of Chicago.

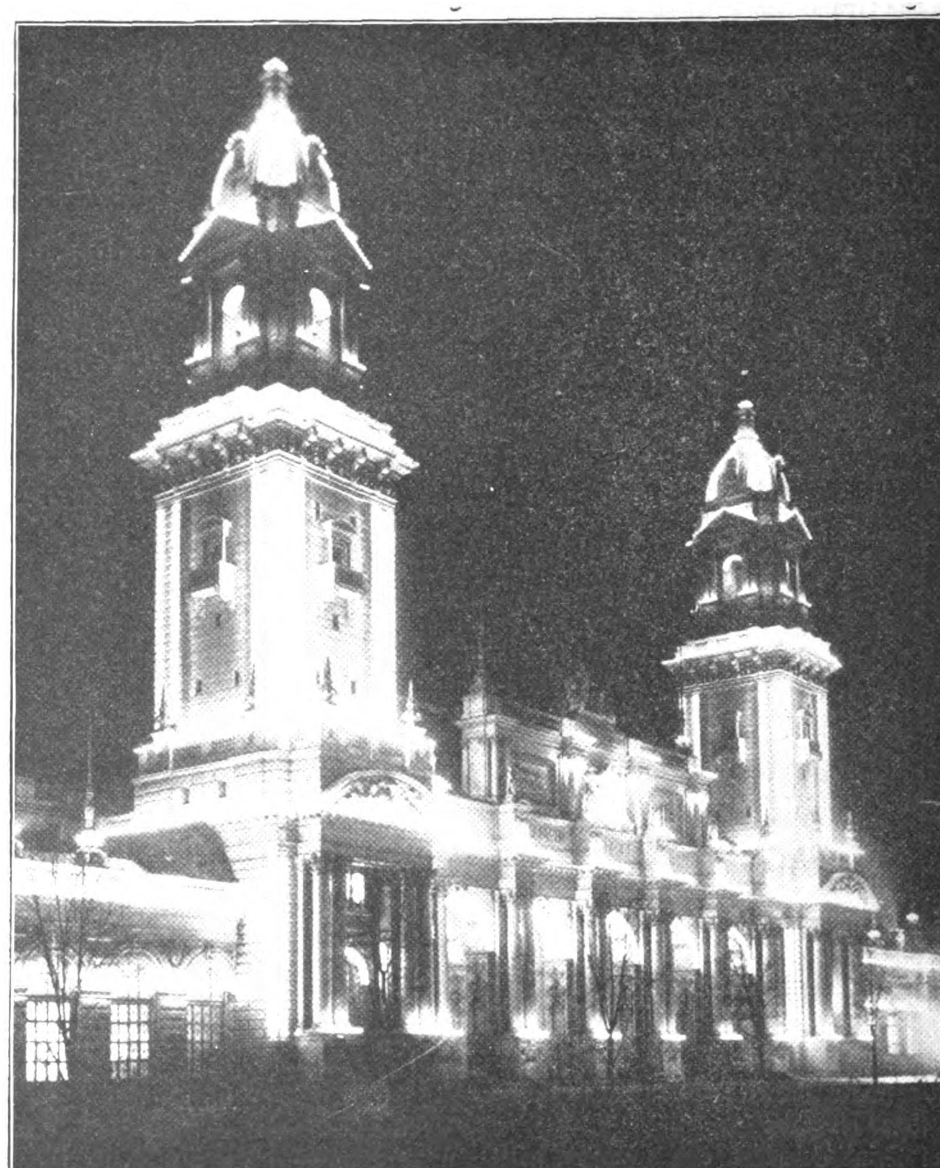
The Allis-Chalmers contract requisitions for six turbines of 5,500 kilowatts (8,250 hp.) capacity. Each to be direct-connected to 25 cycle, 750 r.p.m., three-phase alternating generators of similar size. The generators will be wound to give either 6,600 or 11,000 volts.

One of the turbo-generating sets will be installed in the huge power station which the Brooklyn Rapid Transit people are to build at Kent and Division avenues, Brooklyn. This plant will have an ultimate capacity of almost 100,000 hp. Twelve turbo generators will be put in eventually.

SCENES AT THE ST. LOUIS EXPOSITION.

BY FRANK C. PERKINS.

The electric lighting effects of greatest interest at the Louisiana Exposition are about the Grand Basin, the Cascades, the Palace of Education and the Palace of Electricity. The electrical effects of the Palaces of Electricity and Education on either side of the Grand Basin are very striking, as well as the Cascade Gardens, sloping from the Colonnade to the Grand Basin. The Cascade Gardens are 1,100 feet deep and nearly 2,000 feet wide. The Festival Hall on the hill at the head of the Grand Basin is illuminated by about 20,000 incandescent lamps and several thousand more than this number are utilized in lighting the Palaces of Education and Electricity, the latter being seen in the accompanying illustration as it appears at the present time by daylight. The Palace of Machinery is located on the left of the Court of St. Anthony and the Palace of Electricity on the right. In the background of the accompanying view of the Court of St. Anthony may be noted a portion of the Pike including Roltair's Creation, under the blue dome. This dome is said to be the largest in the world, surpassing in size the domes of St. Peters's and St. Paul's, and measuring 165 feet in diameter. The acoustics of the dome are equally as noteworthy as its size. It contains a whispering gallery, which is said to be so remarkable that it is worth a visit merely to test the wonderful echo and telephonic powers of the inner rotunda.

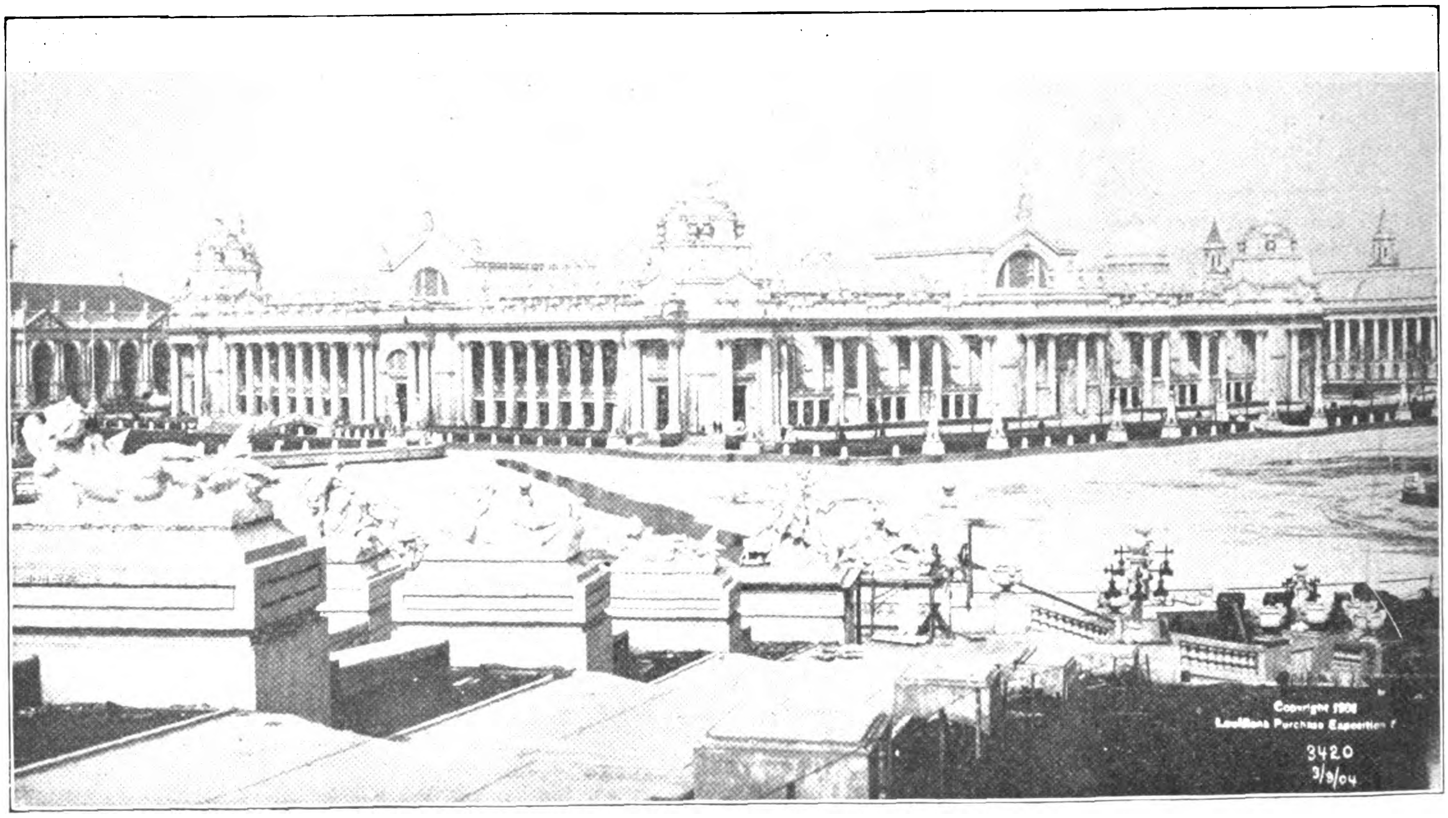


Palace of Machinery at night, St. Louis Exposition.

A good idea of the electric lighting effects is given in the accompanying illustration showing the Palace of Machinery by night. The lamps are located 1¼ feet apart on the rear side of the column on many of the buildings, and this causes the columns to stand out sharply against a very brilliant white background as the light strikes the buildings from 10 to 20 feet behind. The lamps are located a trifle over a foot apart at the main entrances and on the horizon-

tal lines of the cornice and other architectural pieces as well as on the vertical lines of the corner. These lamps serve to outline the buildings in the most interesting manner, as the effect does not show a succession of points, but the lights appear as solid lines, this being particularly noticed in the accompanying illustration of the Machinery Building at night. Several rows of electric lamps are employed on the great dome several hundred feet above the Grand Basin, these lamps being placed very close together, while a spacing of ½ foot is employed for the lamps marking the ribs, entrances and cornice line. These lamps always burn at full brilliancy giving a bright, white light, as no resistance is ever used in series with these circuits.

The three Cascades are supplied with nearly 100,000 gallons of water per minute under a head of over 150 feet. These Cascades consist of a series of 14 falls, each of the three Cascades being nearly 200 feet long. The four fountains in the Grand Basin will require about 14,000 gallons of water while 53,000 gallons per minute will be needed for the main Cascade and nearly the same amount for the two side Cascades combined. This water is supplied by a pumping station under the East Cascade, which is equipped with three alternating current motors, each having a capacity of 2,000 hp., and directly coupled to Worthington turbine pumps of the 36 inch type. These pumps circulate the water from the basin after it has been filtered to the various Cascades, repeating the operation indefinitely.



Palace of Electricity, St. Louis Exposition.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE XI.

BY W. H. WAKEMAN.

Having concluded the consideration of domes and man-holes so far as they weaken a boiler, other features which make it advisable to use a large factor of safety when determining the safe working pressure of a boiler, will receive attention.

Fig. 29 illustrates one of the lugs riveted on the side of a tubular boiler by means of which it is supported in place. When we consider that a boiler 72 inches

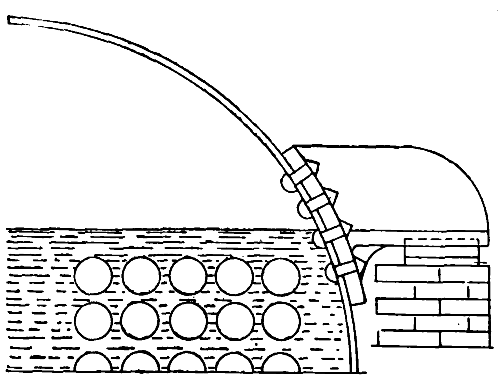


FIG. 29.

in diameter and 18 feet long, carrying two gauges of water weighs many tons, and this great weight is carried by four lugs, it will be plain that a heavy strain comes upon each of them, even when the load is equally divided. If they are not properly supported, one of them will carry more than its share, and this will greatly increase the evil, for it will be noted by referring to the illustration that these lugs exert a prying action on the shell which adds much to the strain upon it, and this comes in addition to the steam pressure carried.

There is no better way of supporting a horizontal boiler, provided each lug carries its proper share of the weight, but this desirable condition is not always realized because a large boiler with these stout lugs firmly riveted to it becomes a very rigid affair, and as the supports rest upon very solid masonry, there is no provision made for preventing the bad effect produced by one brick pier settling a

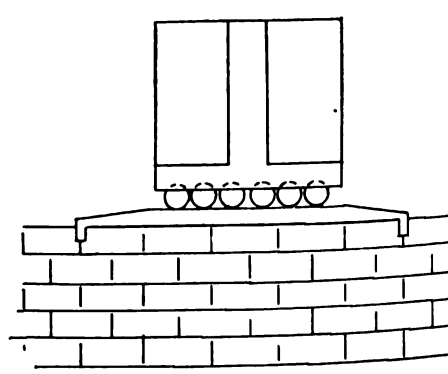


FIG. 30.

fraction of an inch, thus relieving the corresponding lug from much or all of the weight it should carry and throwing it upon the opposite lug, thus greatly in-

creasing the prying action above referred to.

Fig. 30 is an end view of a lug used in the ordinary way to support a boiler. There are six rollers under it, which do no harm except that they increase the expense without proving profitable, for

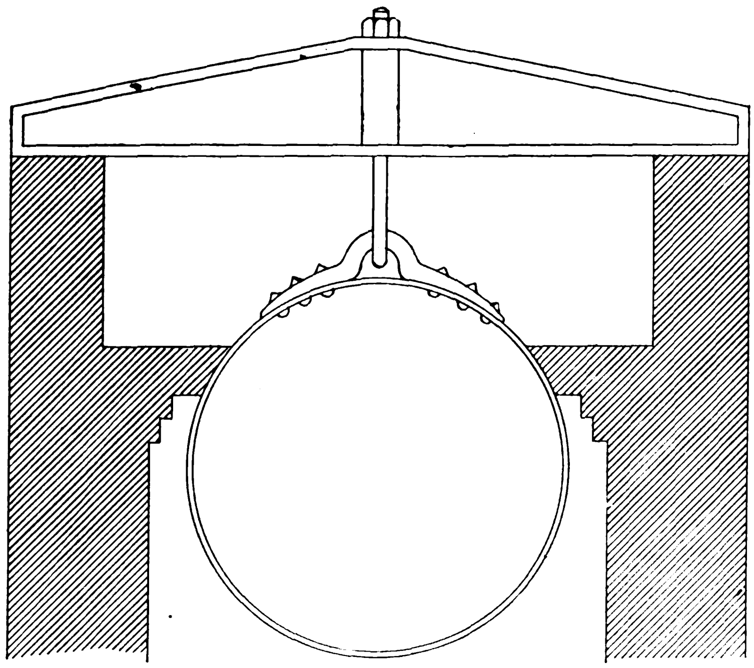


FIG. 31.

owing to the rough surfaces between which they operate, also because they usually consist of pieces cut from a rough rod (without being turned in a lathe) not more than two are actually used, as a rule, and sometimes one carries the whole weight. This action has no special bear-

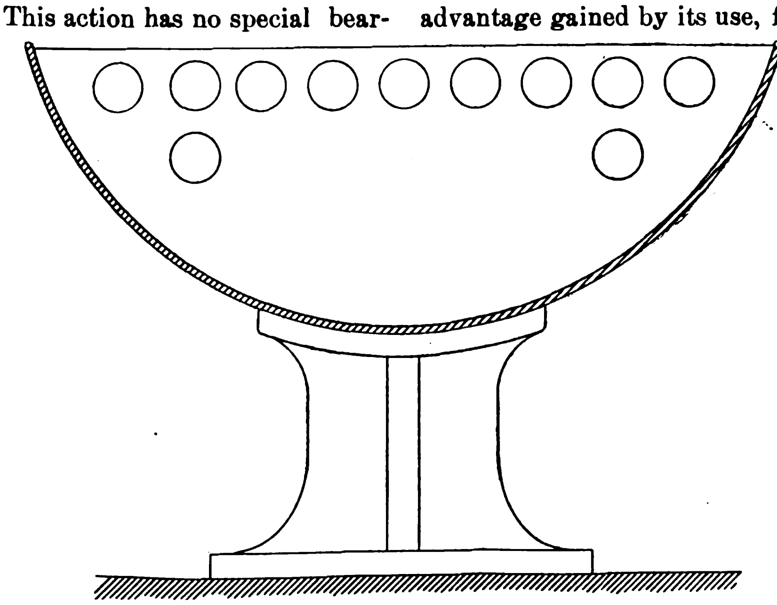


FIG. 32.

ing on the suitable factor of safety to be used, but it does show that while these rollers are provided for the purpose of allowing a boiler to expand and contract easily, lack of care in fitting and setting them, prevents their proper operation for if each of the six carries its share of the load the whole would move more easily.

Some boilers contain six of these lugs, the object of which is to distribute the load over a greater portion of the shell, but in case they are not evenly supported the evil is increased, for if the middle lug on one side is left to carry one-half of the weight, a very great strain comes upon it.

Fig. 31 shows a heavy strap riveted to the top of shell. It is connected to an I beam that rests upon the foundation walls, by means of a stout rod. This brings a heavy strain to bear on the shell near the rivets, but there is at least one advantage gained by its use, for it is possible to throw more than a legitimate load upon it, provided only two are used on a boiler.

Fig. 32 illustrates another plan for supporting the shell, which is not used as much as formerly, as there are several objections to it. Moisture collects at this point, causing corrosion between the two surfaces in contact, which is not always readily discovered, as the device is not accessible for frequent inspection.

No provision is made for the effects of contraction and expansion, therefore a very great weight is brought to bear on a small surface. It has the double advantage of directly supporting the lower portion of shell, which contains the water, and not requiring any holes whatever in the shell, but on the whole this plan is not recommended for reasons already given.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 33.*)

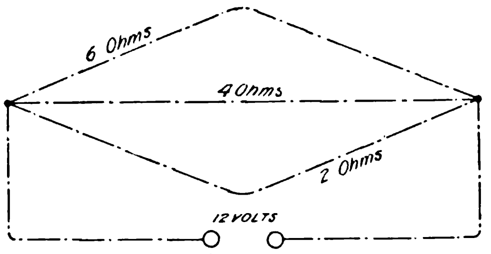
The laying out of circuits in many respects comprises all that may be said about electric wiring, with the exception of a recognition of those principles which include a practical knowledge of the measurement of resistance. The measurement of resistance is not limited to the measurement of the metallic resistance but includes the insulation resistance as well. To measure any resistance calls for a knowledge of the fundamental principle involved in the theory and operation of the Wheatstone Bridge.

The Wheatstone Bridge.—The Wheatstone Bridge is employed for the measurement of resistance and consists of a kite-shaped arrangement of resistances in which each arm of the kite or bridge is a different resistance. In order to grasp the true significance of this device a brief review of the situation with regard to resistances in multiple must be considered. According to Kirchoff's law the total resistance of any number of resistances in multiple can be readily calculated. Not only is the resistance estimated, but the current in each branch and consequently the drop is readily calculated.

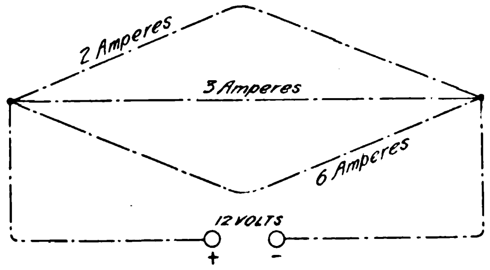
In the following sketches the resistance and current are given, consequently the drop in each branch is 12 volts respectively; that is to say, the application of 12 volts to a resistance of 2, 4 and 6 ohms would mean a current of 6, 3 and 2 amperes and a drop in each circuit of 12 volts. Such being the case, the investigation of the conditions that exist in a circuit composed of resistances forming loops in multiple is similar in many respects to the conditions that exist in a Wheatstone Bridge.

In a Wheatstone Bridge there are two resistances in multiple connected across by a galvanometer or some instrument of equivalent delicacy which indicates the existence of certain conditions. These conditions can only exist when the resist-

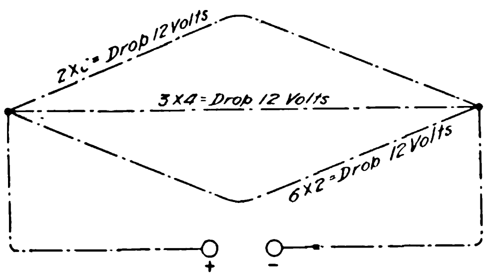
ances bear a certain numerical relationship to each other. The relationship is simple and instructive and can be ex-



Resistance of each Branch

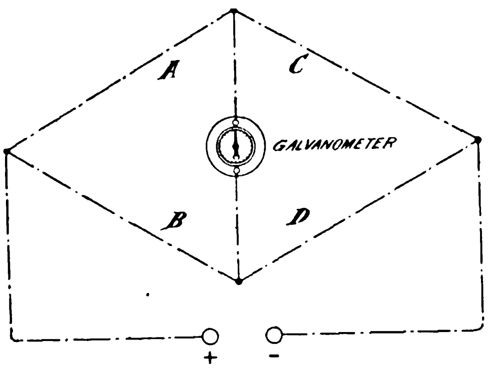


Current in each Branch



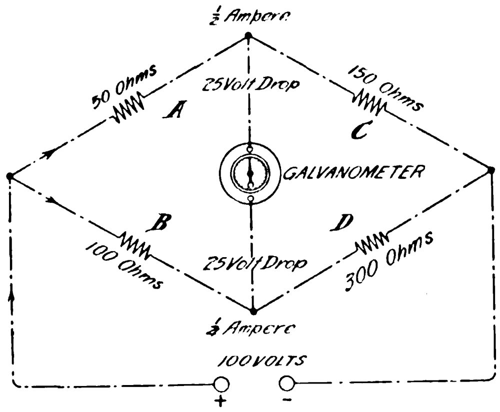
Drop in each Branch

pressed by the conventional formula A : B as C : D, when A, B, C and D represent the four resistances obtained by connecting across the loops by a galvanometer as shown.



Wheatstone Bridge Obtained by Connecting Across with Galvanometer.

The real meaning of this remarkable relationship is, that when the ratio of A to B is the same as the ratio of C to D no current passes through the galvanometer circuit and the bridge is said to be balanced. The explanation of the effect of this interesting condition is to be found in a careful examination of the various drops occurring in the different parts of the circuit designated at A, B, C and D. If values are given to the resistances comprising the respective parts of the Wheatstone Bridge as shown, the following conditions exist:



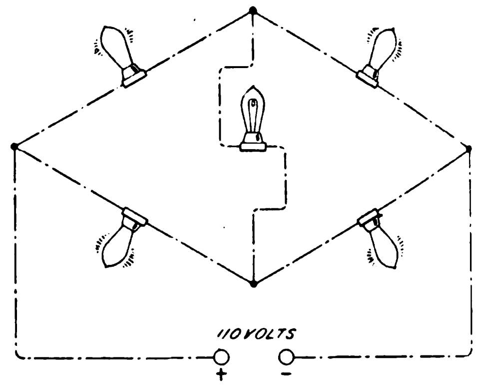
Arm A drop 50 ohms × ½ amp. = 25 volts.
" B " 100 " × ¼ " = 25 "
" C " 150 " × ½ " = 75 "
" D " 300 " × ¼ " = 75 "

In other words, an examination of the theory and practice of the Wheatstone Bridge is merely an examination of the principles underlying the theory and practice of electric wiring. In the illustration it is shown that the points to which the galvanometer is connected are points at which the drop is equal and it follows that these are the only points in the circuit at which the galvanometer will remain at rest. It is therefore only necessary to provide a current and resistance at those points at which the galvanometer is connected whose product is equal at each end and the measurement of resistance becomes a practical possibility.

In the practical application of the Wheatstone Bridge for the measurement of resistance the three arms as they are called, A, B and C, are utilized as follows: A and B are adjusted to a fixed ratio such as 1 : 2, 1 : 10 or 10 : 1,000, etc. C is then manipulated until a balance is struck, that is, until the galvanometer or indicating instrument is at rest. The conditions that then exist are that the arms express the ratio of A : B as C : D. In such a case as this D is the resistance to be found and it can only be found by balancing the bridge. To balance the bridge the unknown resistance is inserted in that part representing the D arm, and when the correct ratio is established the process is completed. The resistance of fields, armatures and other circuits is readily measured by means of the "Bridge" with an accuracy that is without its parallel in other allied sciences.

One of the most instructing of experiments is that of constructing a Wheatstone Bridge of incandescent lamps and noting the fact that when the lamps in the four arms are burning the middle lamp will not burn. (See sketch in next column.)

The entire situation can therefore be summed up in a word, that the drop must be equal in the A and B arms and the indicator or galvanometer will be at rest, and in orderto secure this condition of affairs the resistances of the different arms must express the ratio of A : B as C : D.



Bridge of Incandescent Lamps. Middle Lamp Will Not Burn.

Examples.—If the A arm is 10 ohms the B arm 100 ohms, and the C arm 99.9 ohms, what is the D arm? According to the ratio D = B × C ÷ A = 100 × 99.9 ÷ 10 = 999 ohms. Or the problem may be given in this form: The resistance of a telegraph line is to be measured; the A and B arms are set at the ratio of 10 to 1,000, the telegraph line consists of two loops of equal length and resistance, if the C arm causes a balance when it is 5 ohms, what is the resistance of each loop of the telegraph line? Applying the formula D = 1.000 × 5 ÷ 10 = 500 ohms; but D = the resistance of two loops in multiple, therefore each loop is equal to 1,000 ohms.

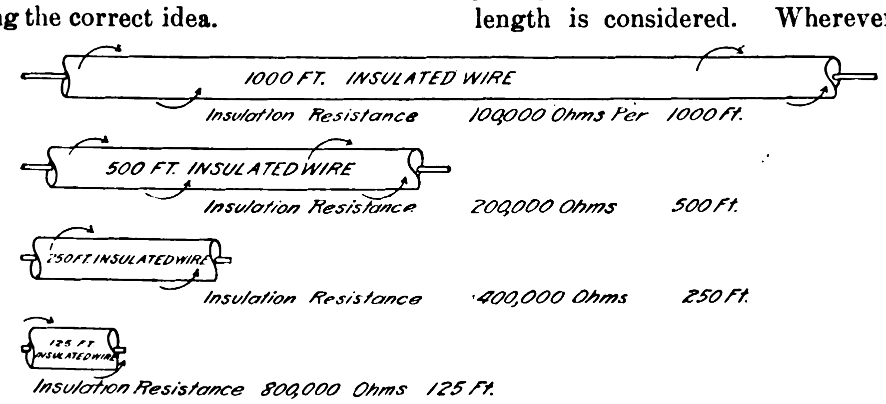
Another example may be found in measuring the resistance of an incandescent lamp hot and cold. If the A and B arms represent the ratio of 10 to 1,000, and the C arm reads 4.5 ohms what is the resistance of a lamp in the D arm? The lamp would have a resistance of 450 ohms cold but its resistance hot would be much less because when at incandescence it takes half an ampere and the resistance would be therefore 110 ÷ ½ = 220 ohms. Almost any resistance high or low can be measured by the Wheatstone Bridge provided the galvanometer is delicate enough. The range of application reaches from .001 of an ohm to one million ohms with great accuracy, or a ratio of about 1 to one billion.

Measuring Insulation Resistance.—The measurement of insulation resistance is one of the most important features of electric wiring because of the requirements of the Board of Fire Underwriters, who represent the insurance companies, and the requirements, self-imposed, by the contractor's conscience.

Strange as it may seem to the uninitiated

even the rubber or gutta percha covering of wires possess a certain degree of conductivity. Where wire is used in large quantities this conductivity makes itself felt to such an extent that the resistance between the copper wire and its covering is greatly reduced in proportion to the amount of wire used and the quality of the insulation employed. It is through this fact that the question of insulation resistance has arisen and requirements have been imposed limiting the amount of current and the insulation resistance in strict proportion to each other. In order to clearly convey an adequate idea of the meaning of insulation resistance as compared with metallic resistance a few illustrations will be necessary.

Suppose 1,000 feet of No. 10 B. & S. wire are considered with a rubber covering of the regular character employed for insulated wire; the metallic resistance is only 1 ohm, but the insulation resistance may be anywhere from 100,000 to 1,000,000 ohms. Supposing the insulation resistance is taken at 100,000 ohms, then the question arises, what is the insulation resistance per foot, per yard and per hundred feet? This question can best be answered by means of an illustration conveying the correct idea.



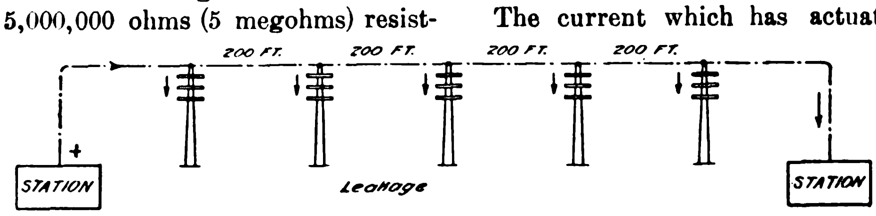
The insulation resistance as shown by the illustration follows just the reverse rule of the metallic resistance. The insulation resistance increases the shorter the wire. If the data suggested by the above sketches is tabulated the following figures occur:

Length of wire. Feet.	Resistance of insulation. Ohms.
1,000	100,000
500	200,000
250	400,000
125	800,000
100	1,000,000
50	2,000,000
10	10,000,000
1	100,000,000

The lesson taught by the above results is this, that the insulation resistance of each foot of wire must be very high in order to give a high general insulation resistance. The resistance of the wire may reach the same figure as the insulation resistance if enough of it be used as shown by the following figures:

No. 10 B. & S. Feet.	Resistance. Ohms.	Insulation resistance. Ohms.
1,000	1	100,000
2,000	2	50,000
10,000	10	10,000
100,000	100	1,000
300,000	300	333
1,000,000	1,000	100

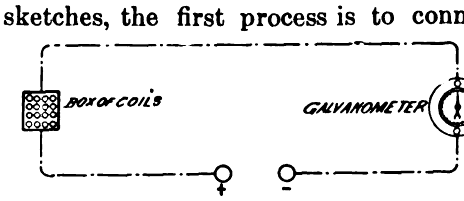
The insulation resistance falls below the metallic resistance according to the above figures when the length of wire becomes greater than 300,000 feet of wire. This amount of wire seems enormous, but when the amount of wire installed in a World's Fair is considered and the wire installed in a 20-story skyscraper in New York City the drop in insulation resistance is a foregone conclusion. The question of insulation resistance is not merely that of the wires installed in a building, but also relates to power lines. The necessity for the use of relays in telegraphic service is largely due to the fact that the current leaks away in transit from one station to the other. As an example of this, supposing a telegraphic line 1,000 miles in length is considered. Wherever it is supported there is a glass insulator of at least 5,000,000 ohms (5 megohms) resist-



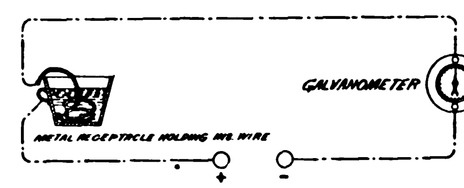
Conditions Existing in a Long Distance Line.

ance. Every 200 feet another pole is erected, making about 25 insulators to the mile. Over a distance of 1,000 miles 25,000 insulators are necessary. This means an insulation resistance of 5,000,000 ÷ 25,000 = 200 ohms over the line from end to end. This is under the best of conditions, when for instance the air is dry and the insulators clean, but in wet or stormy weather the conditions are different. The insulation resistance of not only telegraph poles and lines but power lines as well drops considerably and a heavy leakage is apt to result. In the case of telegraph lines copper wires and high grade insulators may prove of some avail, but where serious leakage occurs with high tension power circuits a grave risk is incurred, beside which the mere question of the cost of power wasted loses its significance.

Measurement of Insulation Resistance.—To measure a resistance of millions of ohms or megohms calls for a delicate and high resistance galvanometer and a box of high resistance coils. As shown in the sketches, the first process is to connect



Connections for First Reading



Connections for Second Reading

the coils and galvanometer in series. Supposing the coils are unplugged and represent 200,000 ohms and the galvanometer gives a reading of 20 divisions. The next step is to substitute the insulation resistance for the box of coils. The coil of wire is taped at one end and then immersed in a boiler of water or any other convenient metal receptacle. The free end is connected in circuit and the metal vessel likewise connected as shown. The second reading may now be taken, it will be very low in all probability. If it is 1 division, then the resistance must be 20 × 200,000 ohms = 4,000,000.

The current which has actuated the galvanometer has found its way through the insulation resistance of the wire and therefore the galvanometer indicates the respective quantities of current which flow when 200,000 ohms is in circuit in one case and the unknown insulation resistance in the other case. Interesting examples can be given in connection with the wiring of buildings as follows:

Example.—What is the insulation resistance of a building using 20,000 feet of wire, the insulation resistance per foot being 10 megohms? The answer is readily

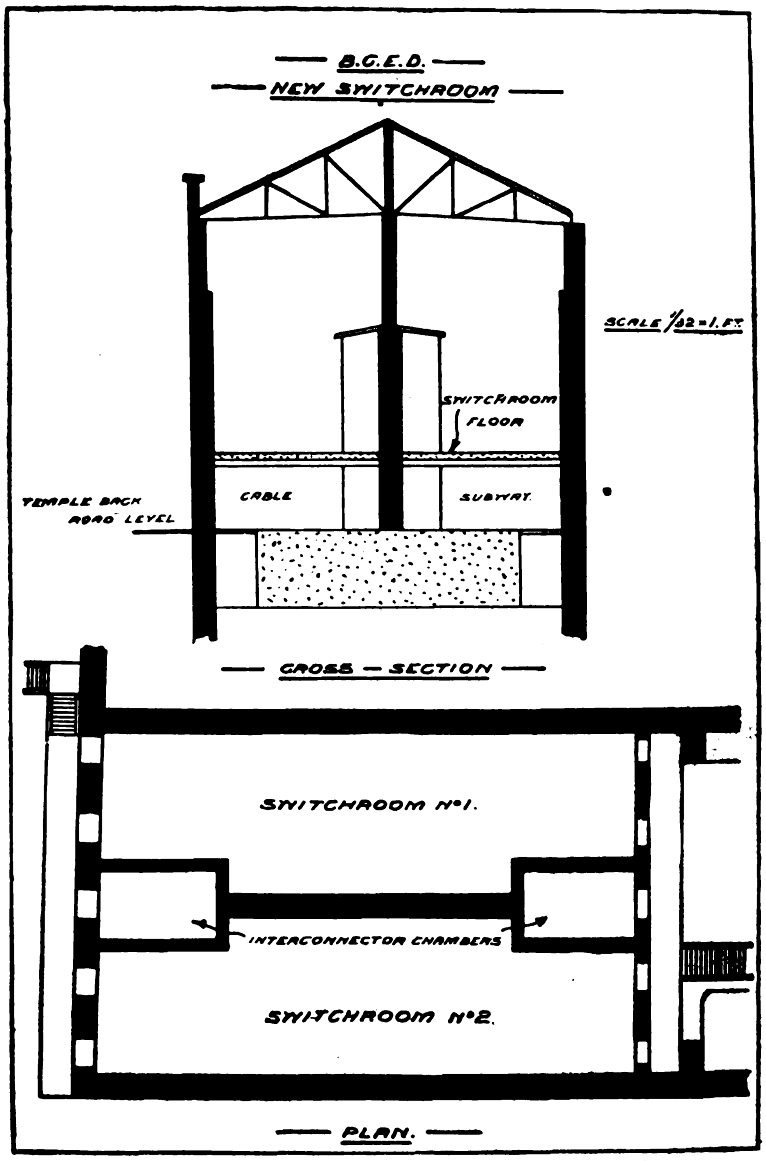
obtained by dividing 20,000 feet into 10,000,000 ohms giving the result 10,000,000 ÷ 20,000 = 500 ohms. In other words, the following fact appears: That as the wire increases in length its metallic resistance *increases* but its insulation resistance *decreases*.

Kinds of Insulation.—The insulating material in vogue for the covering of copper wires may be roughly divided into four general classes. First, rubber; second, gutta-percha; third, composition, and fourth, cotton covering. The last, namely cotton, is in use for magnet and armature wire; the first is generally employed for electric light wire which is usually advertised as rubber covered wire. Cotton covering saturated with paraffin is used in enormous quantities for bell and annunciator work, but a great deal of wire covered with composition is also employed for this purpose. Atlantic or submarine cables are generally protected by gutta-percha coverings from the action of water but, in the course of time, changes in the character of the insulation take place and the rubber, gutta-percha, and particularly the composition coverings break down and the insulation resistance rapidly diminishes. The deterioration is not of serious consequence if the wires are well protected in moulding or conduit, but in old-fashioned buildings, wired ten or more years ago, the risk of fire due to the general deterioration not only of the insulation but the switches, sockets, etc., is very great. The requirements of the Board of Fire Underwriters can be had on application, and a review of the conditions imposed will show the necessity for the selection of the best switches, sockets, wire and conduit in the equipment of a building for electric lighting. The systematic tests for insulation resistance which should be carried on will be a good indication of the value of the materials employed. If the lines are free from grounds and similar defects and the insulation resistance keeps falling it is a sign of the defective nature of the insulating covering of the wires.

FIRE-PROOFING PRECAUTIONS FOR POWER STATIONS.

(From our London Correspondent.)

Early in the present year the English electrical and engineering journals were in the thick of a controversy respecting a serious fire which occurred last December at one of the Bristol municipal electricity supply stations, the switchgear which was the cause of the fire coming in for much attention. With the details of the fire and its effects we need not deal here, but it will be worth while placing on record a note of the outcome of the disaster and the controversy which followed it. This may be gathered from the considerations which particularly influenced Mr. H. Faraday Proctor, the city electrical engineer, when undertaking the reconstruction of the damaged buildings and switch and cable work. It was considered desirable to avoid the following:



Fireproofing Precautions for Power Stations.

(1) The use of oil in porcelain holders.

(2) The use of wood anywhere about the structure of the switchboard floors, unless it is in such form as to be proof against fire. Hardwood blocks set upon a concrete foundation probably form the best and safest description of switchboard flooring as, whilst it is practically unburnable, it affords a good insulation from an electrical point of view, and does not appear to be open to the objections that have been found to exist in the case of glass.

(3) Cables, although armored with lead or steel armoring, must be further protected by being either buried or run in metal casings.

(4) The roof must have in its construction no wood, unless it be thoroughly protected, as in the construction of fireproof doors.

Switchboards of the Ferranti high tension type, such as that upon which the accident occurred, have been very generally accepted as being of the most suitable form for use under the particular conditions of the Bristol system, but according to the view recently expressed by Mr. Proctor before the Municipal Electrical Convention, it seems to be imperative that boards constructed on that principle should not be built into any external wall of a building, for, although the walls of the Bristol generating stations are formed of excellent bricks set in cement and are two feet thick, there is no doubt that with continuous wet weather and strong winds damp has found its way through, and the back slates supplied with the board afford no protection. The accompanying illustration shows the proposed fireproof switch-rooms.

Hull, Mass., is to inaugurate a trackless trolley system from Nantasket Reservation to Nantasket Point, a distance of 2½

miles over the highway. It is expected the system will be in operation by August 1.

SOME NOTES ON TESTING.*

BY C. H. R. T.

A good deal has been written at various times on the subject of testing, and the different tests to which dynamos and motors are usually subjected by manufacturers for the purpose of finding their efficiency, behavior on load, etc., have many times been more or less fully described, but there are several simple little tests which are constantly made use of in the test-room, but which are never mentioned in articles and papers on the subject. Possibly it is owing to their simplicity that they are passed over, but as many of them come in very useful outside the test-room, and are not, in spite of their simplicity, too generally known among average engineers, it may be worth while mentioning a few which occur to the writer.

If a motor has to be tested, it is, of course, best to run it as a motor, but if current at the voltage for which the motor is designed is not available, it may be (and in practice often is) more convenient to run it as a dynamo. In the same way it may happen that no convenient means are to hand for mechanically driving a dynamo which has to be tested, whilst electrical power of the right voltage by which it can be run as a motor is available. In the first case the motor is preferably run as a dynamo, at such a speed as to give the full voltage for which it is designed as a motor--and its speed will obviously be high. In order to find, from its behavior as a dynamo, at what speed it will run as a motor on its proper volts, the following formula is used:

$$\frac{DS}{MS} = \frac{DV + LV}{MV - LV},$$

where DS = speed of machine running as a dynamo;
MS = speed at which machine will run as a motor on its proper volts (viz, MV);
DV = volts generated as a dynamo;
MV = volts for which machine is designed (as a motor);
LV = volts lost in armature and series field coils (if any).

In the second case, the dynamo under test is run as a motor on the voltage which it is designed to give as a dynamo, and its speed will, therefore, be low. In this case the same formula is, of course, applicable, the only difference being that the meaning of the symbols is slightly altered, they being now as follows:

DS = speed at which machine is designed to run (as a dynamo);
MS = speed machine runs at as a motor;
DV = volts machine will give as a dynamo at its correct speed (DS);
MV = volts on which machine is running as a motor;
LV = as before.

In both cases the resistance of the armature and series field coils, for calculating the lost volts, should be taken when the machine is hot after a run, but it is sometimes convenient to take a rough reading of the resistances before the run, in order to get at the size of pulleys, etc., required for the test.

Owing to the fact that when a motor is running as a dynamo, and vice versa, either the speed or the volts (preferably the former) must differ somewhat from the speed or voltage for which the machine is designed; tests taken in this way are not absolutely reliable, but the error is usually very slight, and for most purposes negligible.

In compound motors and dynamos, it is often difficult to see which way the two coils on the bobbins are wound, and consequently they are often coupled up for testing with the series winding opposite the shunt. This, if at first overlooked, is generally noticed on starting up in the case of a motor, or putting the load on in the case of a dynamo (or a motor which has started up all right). When, however, the amount of series compounding is comparatively small, a machine may often be started up and loaded without anything uncanny happening, and the high speed in the case of a motor, or low voltage in the case of a dynamo (neither being very marked), may be put down to faulty calculations on the part of the designer. If there is any doubt about the matter, a convenient and much-used way of satisfying oneself is to short-circuit the series winding for a few seconds, and observe the result on the load. In the case of a dynamo, the load—i.e., external amperes —goes up if the series winding opposes the shunt, and it goes down if the machine is correctly coupled. In the case of a motor, the load—i.e., the external amperes of the driven machine—goes down if the machine is wrongly coupled, and up if it is correct. The reason is obvious. The test is, of course, never required with heavily compounded machines, as the "nigger" will be discovered before getting much load on.

It is usual in manufacturing works to send machines in to be tested when they are in the rough state and not coupled up, in case any alterations are required in the windings. Although, therefore, a machine may have run correctly on test, it is not safe to send it away without a final inspection and coupling-up test by the test-room officials. These coupling-up tests are, of course, very simple, but mistakes are nevertheless sometimes made in carrying them out, and it may, therefore, be of some service to mention the points to be noticed. In these tests it is only necessary to run the machines round for a few seconds without any load, and the quickest and simplest way of doing this is to connect them up to an electrical supply and run them round as motors, even if they are going out as dynamos.

In the case of shunt and series motors these tests are very simple, as they should, of course, run in their proper direction if coupled up correctly. Compound motors should be run on the two windings separately—i.e., the machine should be first run as a shunt motor, the series winding being short-circuited or cut out, and then as a series motor, the lead from the starter to the shunt terminal of the motor being left out. Both on the shunt and the series windings the machine will run in the proper direction if correctly coupled up.

In the case of dynamos a little more attention is required. Shunt dynamos, if correctly coupled up, will run as motors in their proper direction, but series dynamos will run in the wrong direction, or against the brushes. Compound dynamos will therefore run in their proper direction when running on the shunt winding only, and in the wrong direction on the series winding if correctly coupled up.

For these coupling-up tests it is most convenient to have supply mains of fairly low voltage—say, about 100 volts, laid on in a handy place, so that all machines above that voltage may be run on them. Very low-voltage machines are scarce, and special arrangements must be made when they come along for their final test. In running, say, a 500-volt shunt machine on 100 volts, it will often require a push round by hand to start it, but once started care must be taken that it does not attain a dangerous speed, owing to its weak field. The same also applies, of course, to running a series machine, or a compound machine with the shunt disconnected, on no load. If gauze brushes are fitted on a series or compound dynamo, it is advisable to only let the armature make one or two turns, or even only part of a turn, in the wrong direction, as otherwise the brushes may be damaged.

*From the "Electrical Engineer," London.

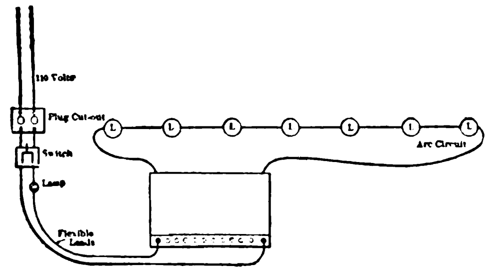
When running shunt or compound dynamos as motors, one end of the shunt winding must, as a rule, be temporarily disconnected from a main terminal, in order to connect it up to the "shunt" terminal of the motor-starter; but this temporary alteration to the final coupling up of the dynamo cannot, of course, affect the direction of rotation. In many cases provision is made on the dynamo for the insertion of a regulating rheostat in the shunt circuit, and then no alteration whatever has to be made in the connections when making the final test.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

LOCATING BREAKS IN SERIES ARC CIRCUITS.

The following is a simple method of locating broken wires or bad connections on series arc circuits. First, it is necessary to run two wires from a lighting circuit of 110 or 220 volts to a point at or near arc switchboard, connecting same to a suitable fused cut-out and switch; second, connect two flexible wires to switch, having them long enough to reach all circuits in board, and placing a lamp of 16 or 32 cp. in series on one of the flexible leads, as shown in the sketch. In case of



CONNECTIONS FOR LOCATING BREAKS.

trouble, such as an open circuit, connect flexible leads to ends of circuit and throw in switch.

The lineman, in looking for trouble, should be provided with a test lamp of proper voltage, with leads long enough to reach across hoodboards and lamps. On placing the ends of test-lamp wires across lamps at doubtful poles, his lamp will light at once provided the break is at this point; if the lamp should not light he will, of course, know that there is no trouble and will go on until he finds the defective wire.

As soon as trouble is remedied the lamp at station will at once light, showing operator at station that the trouble has been fixed.

The lineman will report to station before circuit is plugged in, or, if there is no telephone at hand, an understanding between lineman and switchboard operator allows a certain amount of time after light is lit before throwing circuit on line.

OLD COLONY STREET RY. COMPANY,
Newport, R. I.

CUTTING DOWN OUTAGES ON ARC CIRCUITS.

Our street railway has an average load of 25 amperes. We are arranged with a double overhead trolley, and have a 500-volt storage battery, so run 125-volt, 250-volt, 500-volt motor and trolley circuit from one 500-volt dynamo. The 125 volt is used principally for inclosed direct-current lamps in stores, which are practically all within 2,000 feet of our plant. For 16 cp. work we use 250 volts on the three-wire system. We have about 100 five ampere, 125-volt inclosed arcs in stores, and insist on our customers doing their own trimming. This means, perhaps, more repairs on the lamps, and a greater number of carbons used, but it saves complaint on account of our failure to trim.

We run 73 street lights, series. A penalty for outs is charged by the city. We set the year's penalty at about $300 more than it will be this year, and gave two of our employes all they could save out of this estimate, and they will make about $150 each. The object was to have them keep a close watch of the lamps, and at the same time we gave them a raise in wages, which was due them.

We also give return tickets on our street railway to those who ride before 7 A.M.

E. S. KING, Merrill, Wis.

TESTING OUT SERIES ARC CIRCUITS.

We have a very simple, ready and quick way of testing our arc circuits for open circuits.

We have the alternating current series inclosed-arc system, using tub transformers.

For testing for open circuits we have an incandescent lamp connected to a cord and plug, and by inserting short-circuiting plug on panel board to transformer, and by placing plug connected to incandescent lamp in ammeter jacks, it puts the incandescent lamp in series with the arc circuit, and if the circuit is all right, your lamp will light; if not, the lamp will not light.

C. J. SULLIVAN, Lyons, N. Y.

A PRACTICAL AND INEXPENSIVE SCHEME TO PREVENT OPEN-ARC CIRCUITS.

I have adopted a plan for hanging street arc lamps which is entirely new in some details, so far as I know, although it may be old to some.

Our street series arcs are hung in the center of the intersection of streets. We formerly used No. 6 solid copper weatherproof from the pole of the lamp, but found it broke off very frequently. I next used a duplex No. 8 rubber-covered seven-strand cable. This worked admirably between the pole and the lamp cross-arm, but broke off between the lamp cross-arm and the lamp. I have now used for the past 18 months, without a single open circuit on 50-light circuits, No. 8 duplex rubber-covered seven-strand wire between the pole and the lamp cross-arm and No. 8 49-wire flexible strand between the lamp cross-arm and the lamp binding-post, which I have made standard with the above results.

R. P. STEVENS, Everett, Wash.

AN OUNCE OF PREVENTION WORTH A POUND OF CURE.

Last winter we had a great deal of sleet to contend with, and as we are using the open arcs for street lighting it made us a great deal of trouble during the first storm of this kind with which we had to contend, but after that we tried the experiment which solved the problem, and since that time we have never had a lamp out on account of sleet or ice.

Whenever the carbons begin to coat with ice we take pieces of rather stiff manilla paper, about four inches square, and fold them so that they are cone-shaped, then, after removing the ice from the ends of the carbons, we put this paper above the top of the lower carbon and fasten it in place with a small piece of magnet wire. This makes a complete break between the carbons and prevents the ice from forming on the upper end of the lower carbon. When the current is turned on the paper burns out and the lamp starts off as if there were no ice within a mile of it. There were quite a number of nights last winter when neighboring plants were unable to run on account of the ice, while we had no trouble at all after adopting this plan.

W. A. THOMAS,
Abingdon Electric Co., Abingdon, Ill.

STORAGE BATTERIES FOR TESTING 500-VOLT DIRECT-CURRENT POWER METERS.

It is quite undesirable, for various reasons, to test power meters on the connected or motor load, and on 500-volt lines the necessary resistance box or lamp bank becomes very bulky, and is, therefore, objectionable for mechanical reasons.

The storage battery offers a convenient

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

and efficient method of testing this class of meters on direct-current systems. The nine A. K. storage cell manufactured by the Electric Storage Battery Company is 1¼ inches by 2¼ inches by 5 inches, and weighs approximately 2½ pounds, and for meter-testing three cells connected in multiple are inclosed in a hard-wood box with hinged cover and external binding posts. The total weight is about 12 pounds and the capacity approximately 25 amperes.

In testing a meter it is simply necessary to disconnect the load wire from the meter and connect the storage battery with an ammeter in series to the two terminals of the current coils of the meter to be tested. The resistance of the two battery leads can be made such that together with the current coils of the meter the proper load can be obtained without further manipulation, although a short piece of resistance wire may sometimes be advisable.

BOSTON EDISON COMPANY.

General Electric's Latest Report.

The Boston *Financial News* says that "the profit and loss statement of the General Electric Company for the four months of the present fiscal year from January 31 to May 31, as filed with the New York Stock Exchange, shows a fairly large falling off. If continued for the full year at the rate given for four months, total sales would aggregate $36,-663,000, as compared with $41,669,000 last year, a decrease of $5,506,000. The total for the four months was $12,221,000, which compared with one-fourth of last year's total would reflect a decrease of $696,250.

"The balance after the payment of expenses and interest charges, available for dividends for the four months was $2,-454,000. Dividends paid during the quarter aggregated $877,334 which would represent 2 per cent on $43,866,700. The present outstanding stock is $48,350,000, which would be properly available for dividends for the rest of the year, which would aggregate 6 per cent. and would require $2,501,000, a total for the full year of $3,378,334. By this it will be seen that for the first four months of the present year the company earned within $923,905 of the dividend requirements for the full year."

Removal Notice.

The office and works of the Automatic Switch Company have removed to their old address at 131 Liberty street, New York, where the business will be continued under the management of David H. Darrin, president, and Frederick G. Townsend, secretary-treasurer.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 19, 1904.

Electric Railways and Appliances.

765,185. Controlling Apparatus for Electrically-Propelled Railway-Vehicles. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 29, 1902.

765,216. Trolley-Guard. William C. Washburn, Cincinnati, O. Filed Feb. 24, 1904.

765,265. Railway-Crossing Appliance. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed July 31, 1903.

765,329. B'ock-Signal System for Railways. Richard Tomlinson, Brooklyn, N. Y. Filed Nov. 30, 1903.

765,370. Insulated Rail-Joint. George A. Weber, New York City, assignor to the Weber Railway Joint Manufacturing Company, same place. Filed Dec. 28, 1903.

765,449. Trolley-Harp. Earl R. Warren, Holyoke, Mass. Filed March 7, 1904.

765,516. Trolley. Wilson Selakosky, Lehighton, Pa. Filed Jan. 27, 1904.

765,544. Trolley-Head. Stanislas Bourgeois, Manchester, N. H. Filed Oct. 24, 1903.

Electric Lights and Appliances

765,465-466-617. Method of Starting Gas or Vapor Electric Devices, Starting System and Starting Means for Gas or Vapor Electric Devices. Stanwood E. Flichtner, Englewood, N. J., assignor to the Cooper Hewitt Electric Company. Original application filed Aug. 10 1903. Divided and last application filed Sept. 19, 1903.

765,568. Guard for Incandescent Lamps. Carl W. Eisenmann, Julian, Neb. Filed March 24, 1904.

765,625. Socket for Incandescent Lamps. Norman Marshall, Newton, Mass. Filed Jan. 16, 1901.

Electrical Machinery and Apparatus.

765,173. Variable-Speed-Transmission Device. Rimmon C. Fay, Philadelphia, Pa. Filed Dec. 14, 1903.

765,189. Transformer Insulation. Odus B. Moore, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Nov. 21, 1903.

765,203. Alternating Current Electrical Apparatus. Charles F. Scott, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 13, 1902.

765,207. Brush-Holder for Electrical Machines. Robert Siegfried, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Nov. 21, 1903.

765,209. Method of Operating and Controlling Electric Motors. Norman W. Storer Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Aug. 15, 1902.

765,212. Electromagnetic Block System of Control. Guion Thompson, Duluth, Minn., assignor to the Thompson Safety Appliance Company. Filed March 17, 1902.

765,228. Coil-Retaining Means for Electrical Machines. Isaac De Kaiser, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Nov. 21, 1903.

765,263. Electro Fluid-Pressure Switching-Mechanism. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed July 25, 1903.

765,330. Governing Mechanism for Batteries of Turbines. James Wilkinson, Birmingham, Ala. assignor to the Wilkinson Steam Turbine Company, same place. Filed April 20, 1904.

765,460 Motor-Controller. Henry H. Cutler, Milwaukee, Wis. Filed Jan. 30, 1901.

765,592. Electric Meter. Albert Peloux, Geneva, Switzerland, assignor to the General Electric Company. Filed Oct. 16, 1902.

765,632. E ectric Time-Switch. Carl G. Nylander, McKeesport, Pa., assignor of one-half to Frank J. Regensberger, same place. Filed Feb 15, 1904.

765,653-655. Electrical Switch Operated by Electromagnets. William Grunow, Jr., Bridgeport, Conn. Original application filed Feb. 7, 1902. Renewed Nov. 27, 1903. Divided and last application filed May 17, 1904.

765,654. Art of Controlling Electrical Switches Operated by Electromagnets. William Grunow, Jr., Bridgeport, Conn. Filed Aug. 2, 1902.

Telephones and Telephone Apparatus.

765,213. Memorandum Attachment for Telephones. Robert W. Thompson, Minneapolis, Minn. Filed Feb. 1, 1904.

765,255. Service-Meter for Telephone Exchanges. Charles E. Scribner, Chicago, and Frank R. McBerty, Evanston, Ill., assignors to the Western Electric Company. Filed March 15, 1901.

765,488. Telephone Transmitter. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed April 17, 1903.

765,489. Plug-Seat Switch for Telephone-Switchboards. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Nov. 23, 1903.

Miscellaneous.

765,266. Audible Signaling Device. Walter J. Bell, Los Angeles, Cal. assignor of one-half to Leon F. Moss, same place Filed Jan. 5, 1904.

765,298. Method of Signaling. Richard W. Shoemaker and Lawson H. Giddings, Pasadena, Cal. Filed June 25, 1902.

765,305. Means for Expelling Torpedoes. Francis W. Brady, Englewood, N. J., assignor to the Electric Boat Company. Filed Jan. 3, 1902. Renewed Dec. 19, 1903.

765,311. Signal System. Samuel Friedman, New York City. Filed June 23, 1902.

765,348. Electric Elevator. Ernest H. Vogel, New York City. Filed Nov. 16, 1903.

765,371. Process of Nickel-Plating. Jonas W. Aylsworth, East Orange, N. J., assignor to the Edison Storage Battery Company, same place. Filed Sept. 15, 1903.

765,383. Electric Secondary Clock. Fred I. Getty, Chicago, Ill., assignor to the American Clock Company, same place. Filed Dec. 2, 1901.

765,386. Automatic Fire-Alarm System. John C. Howe, Indianapolis, Ind., assignor of one-half to Clinton E. Prouse and Daniel M. Maroney, same place. Filed April 13, 1903.

765,413. Selective Signaling Apparatus. John J. Comer, Parkridge, Ill. Filed May 23, 1901.

765,435. Alarm Device. George M. Mayer, Chicago, Ill., assignor to Adolphus L. Noel, Mason City, Ia. Filed Dec. 15, 1902.

765,456. Machine for Perforating Telegraph Tapes. Charles L. Buckingham, New York City, and Emil Germann, Brooklyn, N.Y.; said Germann assignor to said Buckingham. Filed Nov. 2, 1899.

765,457. Page-Printing Telegraph. Charles L. Buckingham, New York City, and Emil Germann, Brooklyn, N. Y., said Germann assignor to said Buckingham. Filed Aug. 25, 1902.

765,461. Selective Signaling System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed March 27, 1903.

765,470. Electric Therapeutic Apparatus. Robert Friedlander, Chicago, Ill. Filed June 6, 1904.

765,480. Battery Transmitter. Rasmus Hansen, Chicago, Ill., assignor, by mesne assignments, to the Stromberg-Carlson Telephone Manufacturing Company. Filed June 23, 1903.

765,530. Medical Battery. George F. Webb, Geneva, O. Filed May 3, 1904.

765,550. Electromagnet. Walter W. Brown, Schenectady, N. Y., assignor to the General Electric Company. Filed April 23, 1904.

765,612. Safety Device. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 2, 1904.

Reissues.

12,240. Individual Telephone-Switch and Lock-Out Mechanism for Interconnecting Lines. Albert K. Andriano, San Francisco, Cal., and Hermann Herbstritt, New York City, assignor, by mesne assignments, to the Direct Line General Telephone Company. Filed June 15, 1904. Original No. 691,229, dated Jan 14 1902.

12,241. Controller for Electric Motors. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company. Filed June 21, 1904. Original No. 534,396, dated Aug. 14, 1894.

12,242. Brush-Holder. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company. Filed May 15, 1901. Original No. 648,052, dated April 24, 1900.

12,243. Means for Insulating Electrical Apparatus. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company. Original application for reissue filed May 15, 1901. Divided and this application filed Feb. 20, 1903. Original No. 648,052, dated April 24, 1900.

THE TELEPHONE WORLD.

Long Distance Telephone Service in the West.

The Southwestern Telegraph & Telephone Company in connection with the Pioneer Telephone Company is now prepared to offer its customers first-class copper metallic long distance service to the following cities and towns in Oklahoma and Indian Territory: Ada, Atoka, Caddo, Caney, Eufaula, Holdenville, Kiowa, Muskogee, South McAlester, Tulsa, Vinita, Wagoner, Weleetka and Wetumka, I. T.; Chandler, Edmond, El Reno, Guthrie, Oklahoma City, Shawnee, Tecumseh and Yukon, Okla. The service is being rapidly extended to cover many other points in the Oklahoma and Indian Territories, Southern Kansas and Missouri, where connection will be made with the American Telephone & Telegraph Company's lines direct to Kansas City, St. Louis and lines radiating from those centers.

Improvements are said to be the theme of a recent discussion of John J. Jermyn and John L. Wentz, president and treasurer of the Syracuse, N. Y., Telephone Company. F. M. Potter, Jr., general manager of the company said, when asked whether or not an automatic system would be installed, that the matter has not been determined upon as yet. The company wants to investigate the matter with the utmost care before determining upon an experiment which will involve a large expenditure of money.

A movement is on foot, it is said by parties interested, whereby the stock of the Humboldt. Neb., Telephone Company will be purchased by the recently organized City Mutual cencern, which was granted a franchise and has been preparing to install a second system. The new turn of affairs meets the hearty approval of the business men of Humboldt, who were not anxious to see two exchanges in operation.

According to a report from St. Joseph, negotiations are practically completed for the purchase by the Michigan State Telephone Company of the plant of the Twin City Telephone Company, and as soon as the transfer is made rates will go up. The Twin City lines extend to all points in Northern Indiana and Southern Michigan.

The Suffolk County. N. Y., Telephone Company has certified to the Secretary of State that its capital stock has been increased from $3,500 to $13,500. The certificate is signed by Walter H. Joycox, R. C. Greene, J. T. Losee, Daniel Chichester and M. F. Tiger.

The Colorado Telephone Company of Glenwood Springs is spending $3,000 in putting in cable lines and erecting poles in the alleys. The company is taking down the old wires and es

The Mutual Telephone Company, of Hopedale, Ill., has received its cable and is putting it up. The company is overhauling its system there and giving good service.

James D. Houseman has been elected general manager of the St. Louis, Mo., Telephone Company, and has taken up the work. He has an office in Clayton, where the main office of the company is located.

Long Distance Company Incorporated in Missouri.

Articles of incorporation of the Funston Long Distance Telephone Company were filed in the office of the county recorder at St. Joseph. The company will incorporate with a capital of $15,000, The directors and stockholders are: Edmond B. Funston, 147 shares; Jesse G. Funston, 150 shares; J. J. Funston, 1 share; Thomas J. Porter, 1 share.

The principal office of the company will be in St. Joseph, where the directors reside, except Edmond B. Funston, whose home is at Racine, Wis.

New Telephone Exchange for River Point, R. I.

The contract for the new telephone building at River Point has been awarded by the Providence Telephone Company. Work is to be commenced at once, and the building is expected to be ready for occupancy in about three months.

The new exchange is to be of brick and one story high. and divided into four rooms.

It is understood that the new exchange is to be up-to-date in every respect, and that when it is finished Valley subscribers will have facilities equal to those installed in the city exchanges. Among these it is expected will be a change to the common battery system.

The improvements in the Valley have been largely under the direction of C. T. Howard, the secretary-treasurer of the company.

The Central Union Telephone Company is building a copper metallic circuit between Decatur and Centralia, Ill., and has just completed one from the former city to Cerro Gordo, one from Decatur to Sullivan. and one from Decatur to Maroa. Still another will be put through later from Decatur to Taylorville. The company expects to have additional lines between Bloomington and Springfield before the summer is over. The company is changing a good many poles in Decatur, taking out the short poles and putting in taller ones, and in many instances where the cables are underground the poles are taken out for good. The old poles that can be used are taken to the country and used on the toll lines, where it is not necessary to have them so high. A good many farmers have asked for them to use in putting up private wires, but the company is able to use most of them. The switchboards in the new telephone building are now being wired. It is thought that the company can get into the new building by the last of August.

Receivers have been appointed for the Standard Telephone & Telegraph Company, capital $100,000, which operates in Bucks County, Pa., and in New Jersey. Both the Bell and Keystone companies have been trying to buy the property for some time.

It is expected that the People's Rural Telephone Company, connecting farm houses in Gloucester County, N. J., will be in operation inside of a month. The main office will be located at Wenonah.

The American Telephone & Telegraph Company will complete its line into Meridian from Birmingham and Mobile, Ala., by October 1. Actual work has begun.

Pennsylvania Farmers Interested in Telephones.

A special agent of the Central District & Printing Telegraph Company has succeeded in organizing three farmers' telephone companies within a radius of 20 miles of Johnstown.

At New Florence, the formation of a company which will operate in that vicinity, has been about completed. The organization will probably be known as the New Florence Telephone Company, and will operate over 40 instruments from a central station in New Florence. Among other places which will be fitted with the new 'phones is Rachaelwood Park, the summer home of J. R. Mellon, the Pittsburg capitalist, who is greatly interested in the scheme.

Stockholders of the Wilmore Telephone Company, an organization which will operate in the same way as the one at New Florence, lately met and organized.

The Odenthal Telephone Company, a similar organization which will install about 30 instruments in the neighborhood of Portage, was formally launched a short time ago under the direction of Mr. Henly.

The declaration of a semi-annual dividend of 2½ per cent. upon the preferred stock of the Western Telegraph & Telephone Company by the directors last week in Boston was in the nature of a compromise. Some members of the board were said to be in favor of an increase of 1 per cent. in the rate to a 6 per cent. basis, as provided for under the terms of the reorganization of the Erie Telephone Company, while others, among whom were President Fish, were said to be in favor of paying the old rate now, and of declaring an extra at the close of the year, should earnings warrant it, and if not to allow the dividends to accumulate.

At a meeting of the stockholders of the Crawford County Telephone Company, held in Denison, Ia., recently, a dividend was declared of 10 per cent. per annum. The report of the secretary showed a cash investment of $60,000. After the meeting a committee appointed for that purpose sold additional stock to the amount of over $10,000. Citizens of Denison and Charter Oak and farmers of the county are principal stockholders.

The last link in the coast to coast telephone line has been finished, and now Maine can get connection with Oregon via Kansas City, Denver, Cheyenne, Ogden and thence northwest through Butte. The present facilities in the West limit talking to about 1,000 miles.

The Southern New England Telephone Company has made extensions in Fairfield, Conn.

Telephone Incorporations.

The Burdette Home Telephone Company, Burdette, N. Y. Capital stock, $5,000. Incorporators: H. R. Martin, M. L. Martin and S. B. Allen.

The Farmers & Citizens' Telephone Company, Frankton, Ind. Capital stock, $10,000. Incorporators; Thomas Bromley, Jr., E. H. Phillips and George A. Quick.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Allegheny, Pa.—The committee on public works of this city has approved a resolution for the employment of an architect to prepare plans and supervise the reconstruction and remodeling of the city's electric light plant, recently destroyed by fire.

Alexandria, Va.—This city, which has heretofore lighted its streets from its own electric plant, has determined to grant to Charles Thompson a 30-year exclusive franchise for the sale of electricity here, in consideration of a bonus of $10,000, and the purchase of the city's electric plant at $3,500 and other conditions.

Avondale, O.—The residents have petitioned the board of public service for additional lights and the matter has been referred to the city electrician.

Bainbridge, Ga.—The city council has called a special election for August 8, for the matter of issuing bonds to the amount of $20,000 for the purpose of purchasing the electric light plant.

Bern, Ind.—The Bern Electric Light Company will soon let the contract for the erection of the electric light plant.

Geneva, N. Y.—There is a persistent rumor here that plans are under way for the consolidation of the electric lighting plants of this place, Waterloo, Seneca Falls and Auburn. It is said that the plans have progressed to the extent that a large tract of land has been purchased in East Geneva. The plans call for a most modern lighting plant, with engines and dynamos capable of furnishing sufficient power to light all four places.

Hastings, Neb.—A vast amount of money is being expended here this season in extending the city's water and electric light plants.

Houghton, Mich.—The Houghton County Electric Light Company is arranging to extend its service to the new town of South Range.

Kellogg, Ia.—At a special election held here recently the proposition to vote for the sum of $4,000 to build an electric light plant was voted in favor.

Lake City, Ia.—The Lake City electric lighting plant, which is controlled by local capital, has been leased for a term of years to Otto E. Brownell.

Lansdowne, Pa.—The people of East Lansdowne are talking of establishing electric lighting for that place.

Manistique, Mich.—The Electric Light & Power Company will enlarge its power plant, spending about $50.000.

Milton, Fla.—A franchise has been granted to the Milton Electric Light Company to erect and maintain poles and insulated wires, and to distribute over such wires electric light and power. The construction is to begin within five months from the date of contract.

Oakland, Neb.—A special election will be held here August 8, to vote on $8,000 electric light bonds.

Peabody, Kan.—A company has been organized to establish an electric light and cold storage plant here. The stock has been subscribed for the light plant.

Pontiac, Mich.—The city council will soon let the contract for lighting the streets with electricity.

Preston, Ont.—The taxpayers of this city have decided in favor of municipal ownership of the electric lighting plants. The sum of $27,000 has been raised for the purchase of the existing incandescent plant owned by Mr. Sherer. A new power station will be erected and a first-class plant installed.

Shelby, Mich.—The advisability of either shutting down the municipal electric lighting plant or raising the rates so as to put the plant on a self-supporting basis is being considered and it is possible that bonds may be issued for the installation of a complete new plant, as the present one is inadequate to supply the needs of the village.

Sumner, Ia.—W. P. Walsh is going to build an electric plant here.

Wilton Junction, Ia.—Plans have been made for improving the electric light plant.

STREET RAILWAYS.

Britton, Mich.—There is considerable talk of building an electric road from Toledo, O., to Saline. Promoter Waite, of Chicago, has laid the terms before the citizens on which the road would be constructed. They ask a bonus of $2,500 from this village, and also a range of 10 miles along the route from which to raise the money.

Des Moines, Ia.—President H. H. Polk is interested in the new electric line from this city to Adel.

Dubuque, Ia.—The Union Electric Company will spend about $750,000 on the erection of a new power house, car barn and trackage on its plant here. The power plant will contain a battery of six boilers of 400 hp, each, and six steam turbines and generators that will produce 1,000 hp. each.

Everett, Wash.—P. J. Farley, trustee, has been granted a franchise for an electric railway extending from here north to Skagit County.

Hammonton, N. J.—A trolley road extension to run between Vineland and this place, a distance of 18 miles, passing through Folsom, Buena, Richlands and Landisville, is in contemplation. The matter has been before the board of trade here, and Henry M. Phillips appointed Assemblyman Thomas C. Elvins, Assistant Postmaster Albert L. Jackson and Col. Benjamin W. Richards, special committee to take up the matter of right of way, and to use their influence to have the road built.

Kansas City, Mo.—The Kansas City-Olathe Electric Railway Company has been granted a franchise to operate a road through Wyandotte County.

Lincoln, Neb.—The McCullough-McGowan Syndicate is backing the Omaha-Hastings electric line. It is stated that the syndicate will build several Eastern lines.

Metuchen, N. J.—The Public Service Corporation is installing an electric light signal system on its line from here to Perth Amboy, similar to the one in use on the Middlesex & Somerset single-track lines, for the purpose of doing away with waits on switches.

New York City.—Plans have been filed with the building department of the Bronx for the construction of an immense power house for the New York Central & Hudson River Railroad Company on 149th street, 95 feet west of Long Island Sound. The plans contemplate a three-story brick structure, 236 feet long by 166.64 feet in width, to cost $450,000.

Norristown, Pa.—The Schuylkill Valley Traction Company will build a line from here to Pottstown.

Ottawa, Kan.—Hugh A. Holmes, of Kansas City, was lately given a franchise for 50 years to operate a double track electric road on the main street of this city.

Pekin, Ill.—The Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company has increased its capital stock from $50,000 to $300,000

Pensacola, Fla.—The Pensacola Suburban Electric Company has been formed here by A. C. Berry, J. E. Wolfe and others.

Peoria, Ill.—The Peoria & Rock Island Traction Company has been incorporated with a capital of $100,000, with W. B. McKinley, Charles Zill and others as directors.

Providence, R. I.—F. C. Hinds is at the back of a project to build an electric line from here to Boston.

Syracuse, N. Y.—W. R. Kimball is at the head of a project to build a new electric line.

Tacoma, Wash.—Application has been made by the Puget Sound Electric Railway Company for a local franchise.

Waterbury, Conn.—Local people are interested in the movement on foot to extend the trolley line from Southington and Cheshire Its construction by the Connecticut Railway & Lighting Company, would mean a through trolley line from here to Boston. Credit for the present movement for a more extended trolley service is due to Walter Scott Cheshire.

POWER PLANTS.

Marysville, Cal.—The Downieville-Marysville & Susanville Electric Railroad Company will erect two electric power plants on the Yuba River, one of them to be located near the mouth of Slate Creek, and the other at Bullard's Bar

Pittsfield, Mass.—William A. Whittlesey with a number of other local men, is considering the advisability of starting a new electrical power plant in this city, and plans are being formulated. A stock company is to be organized and the capitalization will be about $50,000. It is proposed to supply this city and vicinity with electricity at a moderate rate.

Redding, Cal.—The Shasta Power Company, represented by Harry L. Shannon, of San Francisco, has been awarded the franchise by the city trustees to conduct a power line through the streets of this city. The company proposes to erect an electric power plant on Hat Creek, 40 miles east from here, to supply power and light to the mines of this county and to towns in Northern California.

Wayne, Neb.—The city power plant is to be improved.

Winsted, Conn.—A company, in which local and New Hartford capitalists are interested, will shortly be formed to generate electricity at Pleasant Valley in the town of Barkhamsted. The intention is to transmit power for lighting and power purposes to surrounding towns. Options on needed land and water rights are now being obtained. A dam 200 feet long will be built, and a storage reservoir covering fully 200 acres of land will be developed.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅝@12¾c.; Lake 12⅝@12⅞c.; casting, 12⅜@12½c.

Official announcement is made that the Westinghouse Electric Company has purchased 6,000 tons of sheet steel.

The Rochester, Syracuse & Eastern Railroad Company is said to be negotiating for the purchase of the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company.

Kuhn, Loeb & Co. have announced that the $4,000,000 Westinghouse Electric & Manufacturing Company's 3-year 5 per cent. notes have all been sold.

The East St. Louis & Suburban Electric Railway Company is preparing a traffic arrangement with the Alton Electric Railway Company for through cars from Alton to St Louis.

The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable August 15. Book close August 5 and reopen August 16.

It is stated that the net earnings of the Philadelphia Electric Company for the first six months of the current fiscal year, ended June 30, were a 12 per cent. increase over those for 1903.

The Brooklyn Rapid Transit Company has made application to the New York Stock Exchange to list $5,000,000 more 4 per cent. bonds, which have been recently sold. This will make $10,000,000 of these bonds listed. The authorized issue is $150,000,000.

The United States Telephone Company reports from January 1 to May 31, 1904, gross earnings $169,487; expenses and taxes, $99,865; net earnings, $69,622; deductions, $41,671; surplus, $27,951.

Philadelphia interests have arranged the sale to the Union Traction Company of the trolley and lighting plants of Fort Wayne, Ind., including a big interest in the Indianapolis Traction & Terminal Company.

Brooklyn Rapid Transit's gross earnings for June, it is reported, increased about $219,000, while operating expenses increased only $3,500. Thus net earnings for June increased $215,000 over the corresponding month of last year, the best showing ever made by the company.

The Shawinigan Water & Power Company, which furnishes electric power to the Montreal Light, Heat & Power Company over an 80-mile transmission line, has executed a mortgage with the Royal Trust Company of Montreal, to secure an issue of not exceeding $6,000,000 five per cent. gold bonds, dated July 1, 1904, and maturing July 1, 1934.

No date has as yet been assigned for the sale at public auction in Boston of the 3,000 shares of West End Street Railway common stock, recently authorized by the Massachusetts Railroad Commissioners. A meeting of the stockholders of the company will be called shortly to authorize the issue. This will make the total amount of common stock outstanding $9,689,250, and the aggregate of both common and preferred $16,089,250.

The New York State Railroad Commission has under consideration the application of the Harlem River and Port Chester Railroad Company for permission to mortgage its property for $15,000,000. In their statement the railroad officers said that great improvements were in contemplation, which, it is estimated, would cost a little more than $5,000,000. With the balance of the money they desire to pay off the indebtedness of $10,000,000, of which $8,500,000 is owing to the New York, New Haven & Hartford Railroad Company.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price July 25
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	151¼
Metropolitan Street Railway	115⅝
Metropolitan Securities	87½
Ninth Avenue	195
Third Avenue	122⅛
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	236
Brooklyn Rapid Transit	51¾
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	67
Philadelphia Traction	98½
Union Traction, $17.50 paid	53½
Boston.	
Boston Elevated, full paid	152½
West End Street, com	91½
do. do. do. pref	112
Chicago.	
City Railway	168
North Chicago	71
Union Traction, com	4¾
do. do. pref	29
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	47
do. do. pref	76
Electric Lead Reduction	¾
Electric Vehicle, com	9½
do. do. pref	14
Westinghouse, com	158
do. pref	190
General Electric	161½
Boston.	
Edison Electric Illuminating	248
General Electric	161
Massachusetts Electric Companies, com	17¼
do. do. do. pref	69½
Westinghouse Electric & Mfg., com	80
do. do. do. pref	93¾
Chicago.	
Chicago Edison	145
National Carbon, com	28½
do. do. pref	101½
Philadelphia.	
Electric Company of America	8⅞
Electric Storage Battery, com	59
do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	132¼
Western Telephone Company	12¾
New England Telephone Company	125
New York.	
American Telegraph & Cable Company	91
Commercial Cable Company	180
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88⅜
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

WHITNEY INSTRUMENTS ENJOINED

Full opinion of His Honor Judge Wheeler, concurred in by His Honor Judge Lacombe, in the case of the

WESTON ELECTRICAL INSTRUMENT CO., Complainant,

vs.

WHITNEY ELECTRICAL INSTRUMENT CO., Defendant.

This suit is brought upon patent No. 392,387, dated November 6, 1888, and granted to Edward Weston for an Electrical Measuring Apparatus, which was adjudged to be valid in Weston Electrical Instrument Co. vs. Jewell Electrical Instrument Co. et al in this Court in March, 1904. It has now been heard upon a motion for a preliminary injunction.

The principal question made now is as to infringement. **The parts of the defendant's instrument look quite differently from the corresponding parts of the instrument of the patent, but notwithstanding these differences in form they are there in the instrument and do the same things in substantially the same way.** This appears quite well from the description of the two instruments in parallel columns in the affidavit of Frank W. Roller, defendant's record on this motion, page 3. The great thing to be done appears to have been to get the movable coil in its diamagnetic frame into a permanent magnetic field, compactly, and to carry the current to be measured from side to side through the coil, and move the coil against steady resistance to measure the current, and record the measurement. Weston seems to have accomplished this by mounting the frame by pivots on non-conducting bridge-pieces, and carrying the current to be measured to and from the movable coil through springs, connected with the frame furnishing steady resistance, and a pointer connected with the frame and moving over a scale to show the movement and the measurement of the current.

Any electrical mechanic could provide the permanent magnetic field, and the form of it would not be material except to permit the movement of the frame carrying the coil. The mounting of the frame on the bridge-pieces by pivots with its arrangement and connections was the important part of Weston's patented invention.

The defendant's instruments have the permanent magnetic field provided by a magnet and core of different and perhaps better shapes in some respects, but permitting movement of the frame in an arc of a circle to carry a pointer moving over a scale to indicate the measurement of the current. **If these changes of forms are even patentable improvements the defendants have taken and used the invention of the patent in making and using those improvements.**

The difference in the form of the parts carrying the frame on pivots supported by the bridge-pieces is of the same sort. It does not vary the mechanical operation of the parts.

These differences do not, any or all of them, amount to doing the same thing in different ways, but leave the operative parts doing the same things in the same way.

According to these views the motion should be granted. HOYT H. WHEELER, Judge.

For Plaintiff:
WILLIAM HOUSTON KENYON.
For Defendants:
CLIFTON V. EDWARDS.

Upon re-examination of the record I concur in the opinion above expressed by Judge Wheeler.
July 18, 1904. E. HENRY LACOMBE, U. S. C. J

(Endorsed). Circuit Court of the United States, for the Southern District of New York.—Weston Electrical Instrument Company vs. Whitney Electrical Instrument Company et al.—Opinion, WHEELER, J.—U. S. Circuit Court, Southern District of New York. Filed July 20, 1904. John A. Shields, Clerk.

WESTON ELECTRICAL INSTRUMENT CO.,

Waverly Park, NEWARK, N. J.

ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

Electric Lighting and Criminality.

It is strange that in the annals of crime a point is reached where science begins to play an all-important part—to act as a powerful deterrent, to be the influence in stemming the flood of moral obliquity that threatens the integrity of city and town.

Electricity does not complete its function in supplying light to the home; perhaps it serves a greater purpose in supplying light outside the home. The conditions existing in a great metropolis like New York are so varied and complex that at night, while millions are at rest, the sneak thief, the burglar, the thug and other night-birds could work undisturbed in many quarters were it not for the electric light.

Police Commissioner McAdoo of New York has hit the nail on the head when he remarks:

"I have always believed that light would prevent a great deal of disorderly conduct at night in certain streets. I do not believe there is anything that would rid us of illegal resorts and clean up certain streets as would light. If they were to give me the charge of lighting New York as well as protecting New York I would at least double the light.

"I know of a place here before which a big light was put. The proprietors practically got down on their knees to have it removed. I would apply the light remedy."

And the light remedy cannot be equaled for efficiency and cheapness. What would the police force of New York number if inferior illumination were employed in the city streets. A conservative estimate would at least double them to secure comparative safety for the public. The great central stations with their immense investments in machinery, real estate and copper perform a service whose widespread advantages are doubly appreciated by the belated traveler and the late home-comer. What value could be placed upon the lives, limbs and money saved by the brilliant lighting of the city streets, had best be left to such men as Commissioner McAdoo, or some other expert in the handling of criminal classes. The municipality had better take the cue, less light, more crime, more light, less crime. There are still dark spots to be found at night within the city limits, where a few powerful arcs would wield an immediate influence. It is easy to see that arc lights are cheaper than police officers and a brightly lit city the greatest imaginable offset to criminality in any stage or form.

It would be only just to state that the inclosed arc has played a very important part in this connection. The older types of lamps could be blown out and their mechanism was frequently defective. The lamps of the inclosed type defy the weather, and can be relied upon to automatically light up without fear of failure.

The city is well protected by the arc, better in fact than ever before, considering the millions depended upon the vigilance of the police and these street lights.

* * *

The Trolley and Steam Roads.

At the present time in this country there are a large number of trolley roads paralleling steam roads. The former gets the passengers, while the latter, as a rule, carries the freight. In this way there is competition, which in many instances has become annoying to the steam road. In other words, trolley development can no longer be ignored by railroads. That this fact is appreciated is made plain by the

action of the Vanderbilt interests in securing control of certain of the trolley systems in this State, and also by similar action on the part of the New Haven road in the New England States. The purpose evidently is to utilize these systems as feeders, instead of antagonizing them. The idea that the electric systems were to furnish real competition with the steam railroads has been abandoned by transportation students, but on the other hand has come to be recognized that, properly conducted, they may become very profitable adjuncts.

Trolley lines, even more than the railroads, offer great inducements to those who would live outside of crowded communities, and with the filling up of the territory served by them they must necessarily make much business for the steam lines. They are, therefore, likely to become, as a Western writer puts it, "tentacles of the steam railway octopus." It is true that they were conceived as rivals to the steam roads, but they have their limitations, mechanical and other. Their rivalry may attain considerable strength, but when they begin to eat up the traffic which they have brought into existence, they will in turn be eaten up, says the *Wall Street Summary*. This may prove to be the case but by that time possibly the so-called steam roads will be using electricity as motive power.

* * *

Aging of Dynamo Iron.

A well-known German technical paper contains a preliminary report of the results of experiments made by members of the hysteresis commission of the Elektrotechnische Verein. The experiments were conducted by Dr. G. Stern, Prof. Epstein and Mr. Soschinski, working independently of each other.

Prof. Epstein observed that heated iron sheets aged at the same rate, whether or not they were simultaneously traversed by induced currents, and his further experiments were therefore confined to heating the iron up-to temperatures of 140 degs, Cent. (284 degs Fahr.) Mr. Soschinski gives particulars about parallel transformer and heating tests, which, on the whole, agree well with one another. It results that transformer iron deteriorates electro-magnetically in the laboratory, where it is exposed to atmospheric temperature changes, even when not experimented upon or used in any way. These increased hysteresis losses are not considerable, however, and a stable condition seems to be reached in two or three months. This conclusion, says *Engineering*, London, does not quite agree with the statement which Dr. Stern made a year ago, when he published a summary of tests he had been conducting in the years 1897 to 1902. It had then appeared to him that there was a steady increase in loss for 17 months; but he had also observed that iron supplied by firms which made a specialty of dynamo and transformer was less liable to aging in this respect, and the results of the recent trials demonstrate that manufacturers have learned mechanically to prepare the iron in such a way that the hysteresis does not much increase afterwards.

Prof. Epstein's figures show the superiority of the iron from well-known firms over the iron he had for these tests obtained from works comparatively inexperienced in this branch. One specimen of iron, at once recognized as not homogeneous, showed a current waste—comprising losses from hysteresis and Foucault currents—of 25 per cent.; but, as a rule, the hysteresis losses amounted to from 3 per cent. to 8 per cent. at the end of two and a half months. The thinner sheets, 0.35 millimeter in thickness, aged more than the 0.5 millimeter sheets (0.014 inch and 0.02 inch respectively). Iron containing 2 per cent. of aluminum gave a loss figure of 33 per cent.; an alloy containing 1 per cent. of aluminum and 0.25 per cent. of silicon a loss of 15 per cent. These alloys, therefore, which Mr. Soschinski tested age very much.

The Foucault current losses, as distinct from the hysteresis losses, were in all cases small, and remained fairly constant throughout the experiments. The just-mentioned aluminum alloys appeared to improve a little with time in this respect.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

There are 29 branches of the American Institute of Electrical Engineers in as many different cities.

The annual meeting of the Ohio Electric Light Association will be held in Sandusky August 16, 17 and 18.

The Arts and Science Congress will be held in St. Louis September 19 to 25, and Signor Marconi and Prof. Pupin are scheduled as speakers on electrical engineering.

A Philadelphia syndicate is considering laying out a special road between New York and Washington to accommodate a regular automobile service. The expense is estimated at $5,000,000, or $6,000 a mile.

Horace Andrews, the Cleveland traction magnate, is quoted as saying that the Niagara, Lockport & Ontario Company will build the largest and most costly electrical power plant in the world. This company's charter gives it the right to transmit power from Niagara Falls as far east as Utica, N. Y., and as far south as the Pennsylvania State line.

There is authority for the statement that the Vanderbilts purpose turning the entire West Shore Railroad between Buffalo and Utica into an an electric line. Furthermore, large sections of the West Shore tracks between Utica and Albany will be used by electric traction companies controlled by the New York Central.

The importations of automobiles at the port of New York have shown an increase of 100 per cent. in the last six months, as compared with the corresponding period of last year, and the demand for automobiles from the manufacturers in this country has been in excess of the capacity of the plants. Nearly all of the factories in the United States are far behind with their orders.

Steam is to be abolished and electricity adopted for moving trains through the Grand Trunk tunnel under the St. Clair River of Michigan. A third rail system will be put in at an expense of $400,000.

The Brooklyn Ferry Company issued an order Saturday forbidding the transportation of any but electric automobiles on its boats. No distinction is made between steam and gasoline machines—both are barred. The order created considerable confusion at the New York ferry entrance on Sunday.

Many prominent men of Washington, D. C., are in a new company incorporated there to exploit certain new water power inventions of William L. Water of Pontiac, Mich., comprising a current motor, a combination tide motor, a wave motor and a hydraulic motor.

The Carnegie technical schools will be the first in the United States to teach electro-chemistry, and the department for this branch to be established in the Pittsburg, Pa., schools will be the most complete in the world. The decision to have a department of electro-chemistry was made by Director Arthur A. Hamerschlag, of the new schools.

The "electric mule" test at Schenectady, N. Y., has shown that the mechanical device could haul six heavily loaded

boats at the rate of 4½ miles an hour. Tests were made with three light, three heavy and six heavy boats, and in each case the electric device was superior to the animals in point of speed and ease in starting. The matter of equipping the canals with electric power may be made a proposition to be submitted to a popular vote of the people of New York State.

TWO INJUNCTIONS IN FAVOR OF THE WESTON ELECTRICAL INSTRUMENT COMPANY.

United States Circuit Court, Southern District or New York.

Weston Electrical Instrument Company vs. Empire Electrical Instrument Company.

This suit is brought upon patent No. 392,387, dated November 6, 1888, and granted to Edward Weston for an Electrical Measuring Apparatus, which has been sustained by a decree of this court on final hearing in Weston Electrical Instrument Company vs. Jewell Electrical Instrument Company, March, 1904. It has been heard on a motion for a preliminary injunction.

The differences between the defendants' instruments and those of the patent are formal and not functional. The parts are different in shape, but they measure currents of electricity by the same means in the same arrangement, and in the same way. That they infringe is not, and cannot well be, much disputed. But at the same time the inventor took out patent No. 392,386 for means by electrical resistance in multiple-arc circuit of dividing the current into definite parts; and measuring one of them in amperes by the apparatus of this patent, which is described in that; and the existence of that patent outstanding and not sued upon is claimed, and is understood, to shield everything covered by it from liability in a suit upon this patent; and that as no infringement but by instruments for measuring by amperes in multiple-arc circuit before this suit is shown, no basis for an injunction is made out. The apparatus of this patent will, when properly adjusted, measure currents of any size, as well as those in multiple-arc, in amperes, as full currents, in volts; and, although measurement in volts is mentioned in the specification and in some of the claims, the patent is not, except as to those claims, limited to measurement of a current in main circuit by volts. The other patent has four claims each of which is for, in some form, the combination of the electrical resistance in multiple-arc circuit with other parts of the apparatus. One patent seems, therefore, to be for the means for dividing a current into definite parts to be measured by measuring one part; and the other patent to be for the measuring any current whether whole or fractional. The former would be infringed only by the fractional means; but the latter would be by the means of either whole or fractional measurement. As the patents were simultaneous there was no abandonment of what was covered in either by description in the other; and no priority in either to prevent a grant by the other if both in any parts covered the same thing, but they do not appear to. Each patent is for a separate invention. and was necessary to secure to the inventor what it covered; and neither affords any excuse for infringing the other.

Motion granted.

Hoyt H. Wheeler, Judge.

William Houston Kenyon for plaintiff.

C. A. L. Massie, Philip Mauro for defendants.

(Endorsed): Circuit Court of the United States for the Southern District of New York Weston Electrical Instrument Company vs. Empire Electrical Instrument Company Opinion, Wheeler, J. —U. S. Circuit Court, Southern District of New York. Filed July 12, 1904. John A. Shields, Clerk.

United States Circuit Court, Southern District of New York.

Weston Electrical Instrument Company vs. Whitney Electrical Instrument Company et al.

This suit is brought upon patent No. 392,387, dated November 6, 1888, and granted to Edward Weston for an Electrical Measuring Apparatus, which was adjudged to be valid in Weston Electrical Instrument Company vs. Jewell Electrical Instrument Company et al in this court in March, 1904. It has now been heard upon a motion for preliminary injunction.

The principal question made now is as to infringement. The parts of the defendants' instrument look quite differently from the corresponding parts of the instrument of the patent, but notwithstanding these differences in form they are there in the instrument and do the same things in substantially the same way. This appears quite well from the description of the two instruments in parallel columns in the affidavit of Frank W. Roller, defendants' record on this motion, page 3. The great thing to be done appears to have been to get the movable coil in its diamagnetic frame into a permanent magnetic field, compactly, and to carry the current to be measured from side to side through the coil, and move the coil against steady resistance to measure the current, and record the measurement. Weston seems to have accomplished this by mounting the frame by pivots on non-conducting bridge-pieces, and carrying the current to be measured to and from the movable coil through springs connected with the frame furnishing steady resistance, and a pointer connected with the frame and moving over a scale to show the movement and the measurement of the current.

Any electrical mechanic could provide the permanent magnetic field, and the form of it would not be material except to permit the movement of the frame carrying the coil. The mounting of the frame on the bridge pieces by pivots with its arrangements and connections was the important part of Weston's patented invention.

The defendants' instruments have the permanent magnetic field provided by a magnet and core of different and perhaps better shapes in some respects, but permitting movement of the frame in an arc of a circle to carry a pointer moving a scale to indicate the measurement of the current. If these changes of forms are even patentable improvements the defendants have taken and used the invention of the patent in making and using those improvements.

The difference in the form of the parts carrying the frame on pivots supported by the bridge-pieces is of the same sort. It does not vary the mechanical operation of the parts.

These differences do not, any or all of them, amount to doing the same thing in different ways, but leave the operative parts doing the same things in the same way.

According to these views the motion should be granted.

Hoyt H. Wheeler, Judge.

For Plaintiff—William Houston Kenyon.

For Defendants—Clifton V. Edwards.

Upon re-examination of the record I concur in the opinion above expressed by Judge Wheeler.

E. Henry Lacombe, U. S. C. J.

July 18, 1904.

(Endorsed): Circuit Court of the United States, for the Southern District of New York.—Weston Electrical Instrument company vs. Whitney Electrical Instrument Company et al—Opinion, Wheeler, J.—U. S. Circuit Court, Southern District of New York. Filed July 20, 1904. John A. Shields, Clerk.

SAFE PRESSURES FOR STEAM BOILERS.

ARTICLE XII.

BY W. H. WAKEMAN.

(*Concluded.*)

Fig. 33 represents a boiler containing four horizontal shells, one of which is a sort of mud drum, while the others are carried a little more than one-half full of water. Nine rows of tubes are shown, and by referring to Fig. 34, which is a front view of the same boiler, we see that each row contains 31 tubes, therefore the lower shell or mud drum has 279 holes in it for tubes, and one for a blow-off pipe.

Each of the upper shells or steam drums receives 93 tubes, and as a rather large hole is bored for each tube, the shells are very much weakened thereby.

The bursting pressure of these shells is high, provided the effects of boring holes in them is ignored, but it must not be overlooked in practice, as it is an important consideration, therefore a large factor of safety must be used.

Fig. 35 is a plan of an upright boiler that gives very good results in practice. The inner circle represents the vertical shell into which numerous tubes are expanded, the outer ends being closed as shown. They extend nearly to the masonry setting, therefore as heat travels upward from the circular furnace it envelops these outstanding tubes, rapidly evaporates water contained in those below the water line, and superheats steam in those above it.

This circular illustration shows 20 tubes and Fig. 36, which is an elevation of the same boiler, represents 33 rows of them (in circular form); therefore, in this boiler there are 660 holes bored in one shell and a tube expanded into each.

These boilers are designed to be perfectly safe under pressures they are to carry, but the point made in this connection is that when calculating the safe working pressure a large margin must be allowed for the weakening effect of these holes bored for tubes, for if tensile strength and thickness of plate, efficiency of joint and diameter of shell are used to determine the bursting pressure, the factor of safety must be much larger, when the safe working pressure is fixed, than is required where no tubes are expanded into the vertical shell.

The foregoing caution concerning the adoption of a proper factor of safety has been applied to the more common forms of boilers, but there are many other kinds, classified as water tube boilers, etc., that are of special designs, therefore they require special consideration, which cannot be given here, but enough has been presented to show that this is a very important part of the problem and failure to appreciate this fact has cost much labor and money.

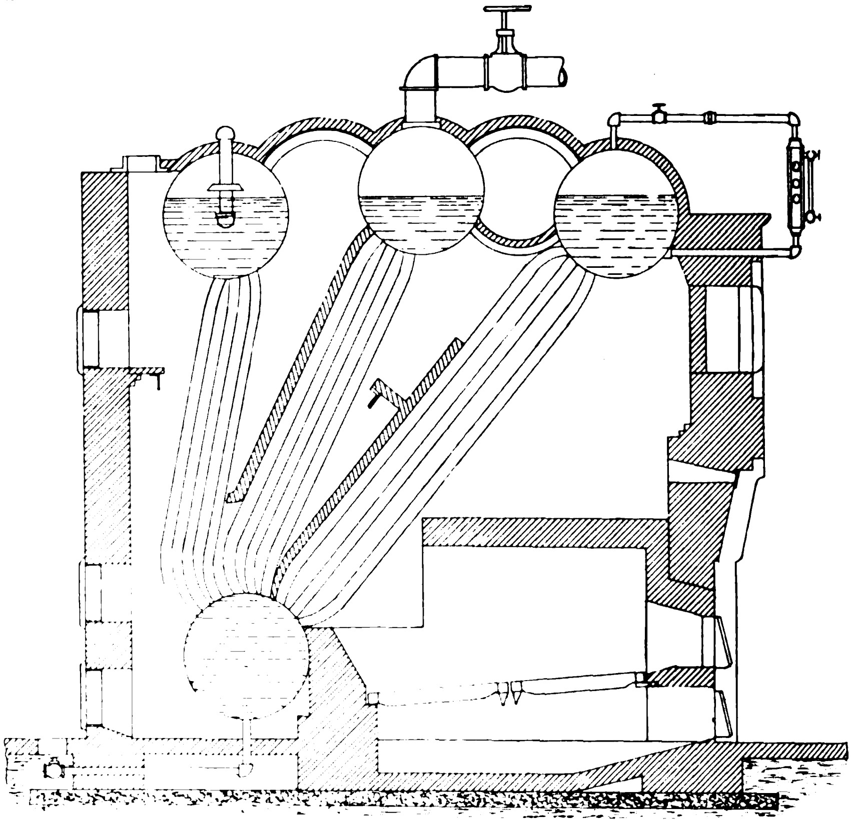


FIG. 33.

One illustration of this will be of interest in this connection. A certain boiler maker began to make a water tube boiler that promised to give excellent results. More enthusiasm than discretion was exercised in the enterprise, causing him to produce several of these boilers before testing one of them. The consequence was that after installing them in an important plant they failed under the insurance company's te t and were condemned. The expense of strengthening

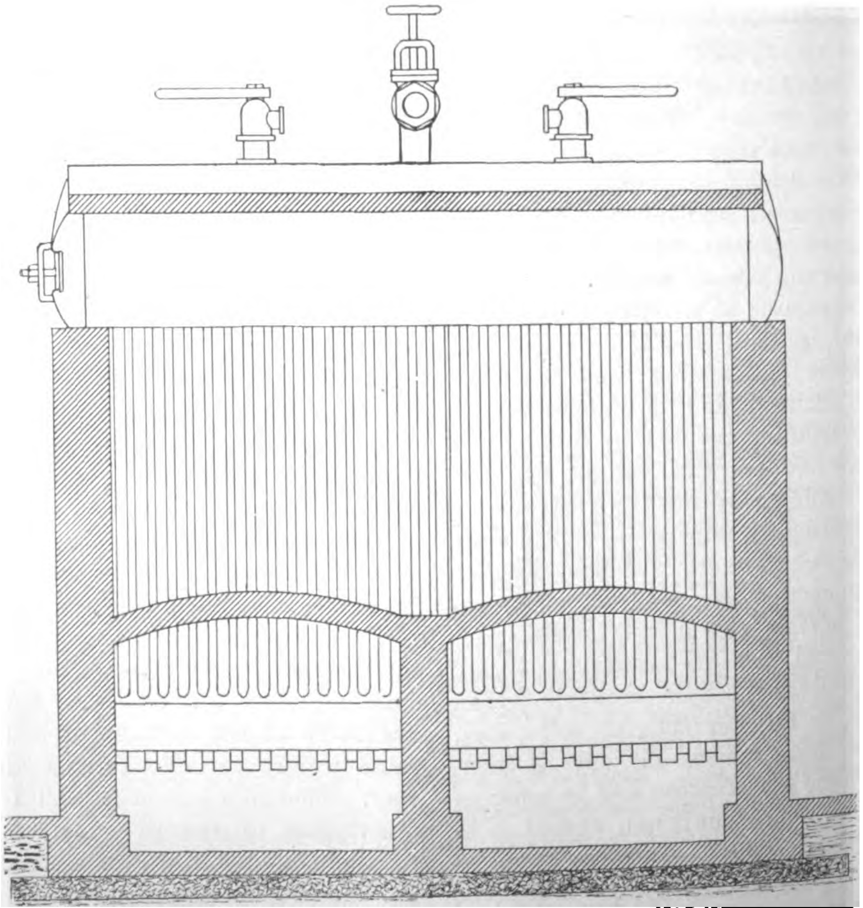


FIG. 34.

the weak places, replacing setting, etc., proved ruinous, putting the boiler maker out of business.

While the result was disastrous to him, it was fortunate that the defect was discovered before the boilers failed under steam pressure.

The foregoing explanations and illustrations have been presented in connection with new boilers in which every part is supposed to be in good order, but second-hand boilers are worthy of careful attention, as they are very deceptive except to the experienced boiler inspector, who soon tells if they are defective; therefore no second-hand boiler should be reset and put into service again until said inspector has made a careful and intelligent test, reported his findings, and his company has issued a policy of insurance at a reasonable cost.

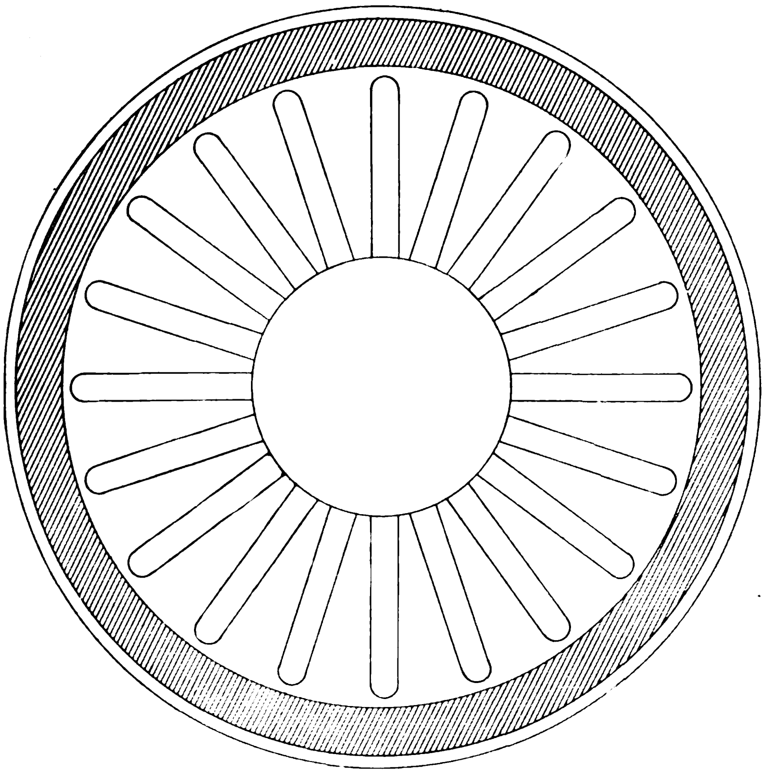


Fig. 35.

This is the safest and best plan to adopt and its cost is not prohibitive.

The steam engineer who aspires to be more than a mere "starter and stopper" should study these rules and the principles on which they are based until thoroughly familiar with them. I do not claim that it is necessary to commit all of them to memory, but one or two should be used frequently for the purpose of remembering the same, and the time will surely come when they will prove valuable.

A recent fire in St. Petersburg, Russia, destroyed the largest electric cable wire factory in that city, with the loss of about $1,250,000. A large quantity of cables and wires for the torpedoes and mines intended for the Baltic squadron was destroyed.

A NEW RULE FOR BELT CALCULATIONS.*

BY YRREB.

After a new machine (either electrical or mechanical), has been fixed and the belt attendant summoned to measure for the length and width of band required, one of the greatest difficulties the average belt man has to contend with is as to the width and thickness the band is required to be in order to transmit sufficient energy to obtain the maximum rated output from the new machine. The length is easy enough to measure, but the width and thickness is quite another matter altogether; so that, generally speaking, the only guide the non-technical man has to help him in deciding the width of band he will use is the width of the face of the pulley, or the band guide which is usually supplied with the machine. Then, if by some mistake or other, the pulley supplied with the machine is rather wider than is necessary, the purchaser or employer of the belt man is put to the extra expense of buying an unnecessarily wide band owing to the man's inadequate knowledge of belt tensions or of belt driving generally. On the other hand, should the pulley supplied with the machine be too narrow or too small in diameter for the full or rated amount of work the machine is guaranteed to perform, the man whose duty it is to attend to the banding is being continually called upon to either use some band solution or again tighten up the band every time the machine is being worked up to its rated output. In the case of having to be continually tightening up, the band eventually reaches its breaking strain, and so causes a complete stoppage. This bad practice not only causes an excessive tension on the band, but very considerably reduces the life of the shafting, loose pulleys, bearings, etc., which causes a loss of time, money and temper, and is altogether unsatisfactory.

*From the "Electrical Engineer," London.

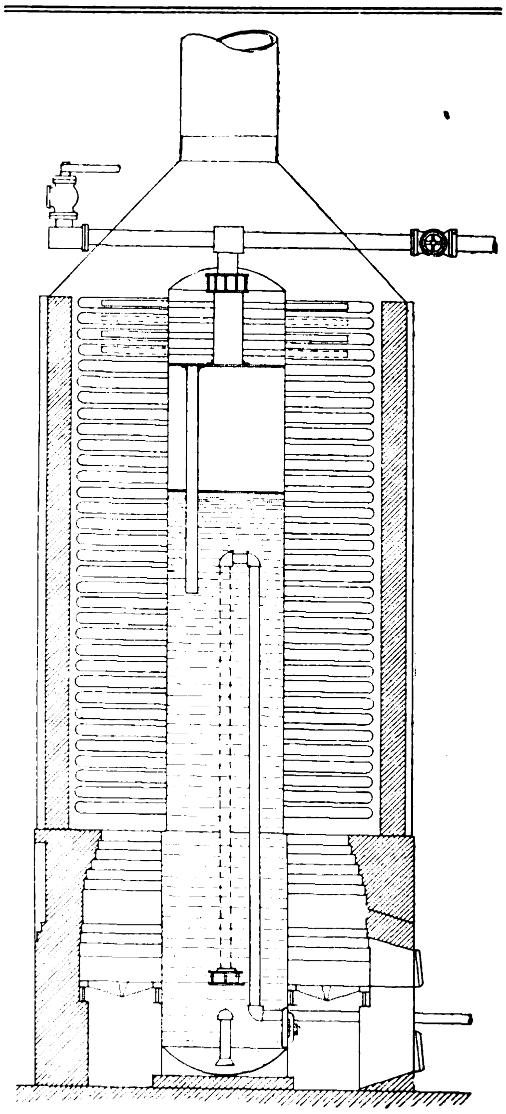


Fig. 36.
(*Safe Pressure for Steam Boilers.*)

After many years' of experience of belt driving and general engineering the writer has found that a good all-round and easily-remembered rule for belt calculations is that 1 foot per minute of belt speed per inch width of belt is safely equal to transmitting one watt of electrical energy. So that if we multiply the band speed in feet per minute by the width in inches, the result will be the total energy in watts or (dividing by 1,000) in kilowatts that the band can be safely relied upon to transmit without any

undue tension being brought upon any part of the band or excessive friction on any part of the machinery. It must be strictly understood that this data only applies to single leather belting or woven bolt of equal thickness. If a light double leather band be employed, then 25 per cent. more energy may be calculated upon, or for a heavy double leather band as much as 60 per cent. more may be added. The great advantage in adopting this rule is that it fixes a constant for working tensions, so that the working tension becomes directly proportional to the width in inches, the constant being 44.24 lbs. full per inch width of belt. Therefore if it is required to know what is the difference in the pull of the tight side over the slack side of any belt, all we have to do is to divide the total output of the machine measured in watts by the velocity of the belt measured in feet per minute and multiply the result by 44.24, and the product will be the extra pull in pounds of the tight side over the slack. It also conveys some idea to the average man when he is deciding upon a belt as to what amount of stress is likely to be brought upon the band when being fully worked up to its maximum load, thus obviating all troubles arising from bands being either worked excessively tight or ridiculously slack. The above working tension per inch width of belt is fairly low, being one that any class of banding should stand. It would also tend to increase the life not only of the banding itself, but of all loose pulleys, shafting, bearings, etc.

As this article is written chiefly for non-technical men, perhaps it will not be out of place to briefly explain the meaning of some of the mechanical and electrical terms that will be used in some of the examples about to be taken. "Mechanical energy," or rate of doing work, is always measured in foot-pounds per minute, which means that in the case of raising a weight, if the total weight in pounds be multiplied by the height measured in feet to which the weight will be raised in one minute, the result will give the rate of doing work expressed in foot-pounds per minute, and 33,000 foot-pounds per minute is equal to 1 hp. For instance, a 1,000 lbs. weight raised 33 feet in one minute is just equal to 1 hp., as $1{,}000 \times 33 = 33{,}000$ foot-pounds per minute; or one ton weight raised 10 feet in one minute $= 2{,}240 \times 10 = 22{,}400$ foot-pounds per minute $= \frac{22{,}400}{33{,}000} = .679$ of 1 hp. Electrical energy is usually measured in watts; one watt is equal to 44.24 foot-pounds of work per minute, and is also equal to 10,000,000 ergs per second, 746 watts being equal to 1 EHP. If we wish to measure the electrical energy in watts we multiply the volts by the amperes; therefore the total output for any dynamo is amperes $\times$ volts = watts, or $\frac{\text{amperes} \times \text{volts}}{746}$ = EHP, (electrical horse power). Then, turning back to our rule, which teaches us that 1 foot per minute of belt speed per 1 inch width of belt is equal to one watt of electrical energy, we find that if we divide the total output (of any dynamo or motor) given in watts by the velocity of the belt measured in feet per minute, the result will give us the width of belt required for that dynamo or motor.

Another item that might be worth while explaining is circumferential speed of pulleys and velocity or belt speed. To ascertain the circumferential speed of a pulley we must multiply the diameter of the pulley in inches by 3.1416 (which is a constant usually denoted by π), and then by the number of revolutions per minute at which the pulley runs, and dividing the product by 12 we get the circumferential speed of the pulley in feet per minute. For example, a 12 inch diameter pulley runs at 1,000 revolutions per minute; find the circumferential speed of the pulley in feet per minute.

$$\frac{\text{Dia} \times \pi \times \text{revs. per min}}{12} = \frac{12 \times 3.1416 \times 1{,}000}{12}$$

$= 3{,}142$ feet per minute. The circumferential speed of a 20 inch diameter pulley running at 400 revolutions per minute $= \frac{20 \times 3.1416 \times 400}{12} = 2{,}094$ feet per minute. Now, when calculating the belt velocity or speed of a belt in feet per minute, to be correct we must add the thickness of the leather band to the diameter of the pulley and proceed as before. But we must remember that there is a percentage of slip and creep going on continually with every belt that is doing work. So that having to consider these small factors when making calculations somewhat complicates matters and yet does not materially affect the net results one way or the other. In the writer's opinion, therefore, these might be neglected altogether, and consider the circumferential speed of the pulley as being the belt velocity, which will simplify the method considerably without any serious errors arising from doing so.

Then formulating the rule, letting

W = width of belt in inches,
T = driving tension per inch width of belt,
V = velocity of belt in feet per minute, and
F = total driving tension of belt, we have

(1) $W \times V$ = output of machine in watts.

(2) $\frac{W \times V}{746}$ = E.H.P.

(3) $\frac{\text{Amps.} \times \text{volts}}{V} = \frac{\text{watts}}{V}$ = width of belt required (W).

(4) $\frac{\text{H.P.} \times 746}{V} = \frac{\text{watts}}{V}$ = width of belt (W).

(5) $\frac{\text{H.P.} \times 746}{W} = \frac{\text{watts}}{W}$ = velocity of belt (V).

(6) $\frac{\text{H.P.} \times 33{,}000}{W \times V}$ = driving tension per inch width of belt (T).

(7) $W \times T$ = total driving tension.

Example I.—A dynamo runs at 1,000 revolutions per minute with an 8 inch diameter driving pulley. The output of the machine being 100 amperes at 50 volts, what width of belt is required to drive it?

Since speed of band = circumferential speed of pulley $\therefore$ speed of band $= \frac{8 \times 3.1416 \times 1{,}000}{12} = 2{,}094$ ft. per min., then by (3) width of belt $= \frac{\text{Amps.} \times \text{volts}}{V} = \frac{100 \times 50}{2{,}094} = 2.4$ in.

So that a belt 2.4 in., or, say, $2\frac{1}{2}$ in. wide will be required.

Example II.—A 20 hp. motor has a 14 inch diameter pulley running at 850 revolutions per minute, what width of belt will be required for the motor in order to transmit the full output of the machine?

Velocity of belt $= \frac{\text{Dia. of pulley} \times \pi \times \text{revs. per min.}}{12}$

$\frac{14 \times 3.1416 \times 850}{12} = 3{,}116$ ft. per min.

Then by (4) $\frac{\text{H.P.} \times 746}{V}$ = width of belt $= \frac{20 \times 746}{3{,}116} = 4.788$ in., or say $4\frac{3}{4}$ in

Example III.—A steam engine with a 7 foot diameter driving pulley running at 90 revolutions per minute is capable of developing 30 BHP. at the driving pulley; what width of belt will be required, and

what will be the difference in tension in pounds pull of the tight over the slack side of the belt?

$$\text{Velocity of belt} = \frac{7 \times 12 \times 3.1416 \times 90}{12}$$

= 1,979 ft. per min.

$$\text{Width of belt} = \frac{\text{H.P.} \times 746}{\text{V}} = \frac{30 \times 746}{1,979}$$

= 11.31 in., or, say, $11\frac{3}{8}$ in. wide.

Then by (6) $\frac{\text{H.P.} \times 33,000}{\text{W} \times \text{V}}$ = driving tension per inch width, and $\frac{\text{H.P.} \times 33,000}{\text{W} \times \text{V}}$ $\times$ W = total driving tension or difference in tension in pounds pull of the tight side over the slack

$$= \frac{30 \times 33,000 \times 11.31}{11.31 \times 1,979} = 500 \text{ lbs. pull.}$$

The simplicity of this rule, and the easy way in which calculations of this kind can be performed, will at once be apparent from the foregoing examples.

Convexity of Pulleys.—All pulleys, as far as possible, should be slightly convex or rounded on the face for the purpose of maintaining the band in the middle of the pulley, but as to what amount or extent they should be rounded is a point which engineers do not generally agree upon. Therefore it is no uncommon thing to see a band running upon two pulleys with a wide difference of convexity or roundness of face. In fact, one can see at times a band running from one pulley (probably the driving pulley) with a very much rounded face to another which has a perfectly flat face, which, to say the least, would not be considered good practice, and would be very injurious to the band, especially where dry resin is freely used. In order to adopt a universal convexity for all pulleys, the writer would suggest that to square the width of the face in inches and add 10 inches would give us a radius in inches for striking the arc of convexity, from which sheet steel gauges could be made. For example, take a pulley with a 6 inch face, then by the rule $6 \times 6 + 10 = 46$ inches radius, an amount which will be found to be thoroughly consistent with good practice, and one that will give very satisfactory results for any reasonable width of face or diameter of pulley. But to speak to an average workman about squaring the width of the face in inches to find a radius for striking the arc of convexity would probably sound like so much Greek; therefore, for the sake of completeness, it may be added that the square of a number is the number multiplied by its own value, which process would be spoken of as raising a number or quantity to its second power, and is usually denoted by placing a small figure 2 over the quantity to be raised.

As $7^2 = 7$ squared = the second power of $7 = 7 \times 7 = 49$, or $6^2 = 6$ squared = the second power of $6 = 6 \times 6 = 36$, or $10^2 = 10$ squared = the second power of $10 = 10 \times 10 = 100$. This is called the process of involution. Therefore, the square of the face in inches of a pulley with a 10 inch face equals 100 inches, and adding the extra 10 inches, the sum, 110 inches, would be the radius in inches for striking the arc of convexity.

Centrifugal Force.—When belts are in motion, they are subjected to a stress arising from the action of centrifugal force, in addition to that due to transmission of power. But this only need be taken into account when belts are running at a very high velocity, such as 4,000 feet, 5,000 feet, or even 6,000 feet per minute. At the ordinary speeds which are usually adopted for long lengths of line shafting, and, in fact, general machine driving, the effect of centrifugal force does not materially affect our calculated results. Therefore, this force need not be considered in any case when the belt velocity is below 3,000 feet per minute. But in anything above 3,000 feet, per minute the effect of centrifugal force tends to impair the general efficiency. It is often remarked that a good long belt drive is far more efficient than any short one, and also that all belts run to the highest point of the pulley. Both of these statements are apt to be somewhat misleading, and should therefore never be accepted as a general rule, because there may exist certain conditions which would render a long drive less efficient than a reasonably short one. It can be shown that in the case where both driving and driven pulleys are of the same diameter there is no particular advantage in having a good long drive (whatever that means), for precisely the same results can be obtained with a reasonably short (say 8 feet) drive as with an 80 foot one without any extra tension on the short band or machinery, both bands being the same width and thickness. But if we take a case where the diameters of the two pulleys differ, say with a ratio of 4 or 5 to 1, then it is an advantage to have a fairly long drive of belt. But here, again, it can be shown that it is utterly impossible to get the lengths of the two band arcs or band grips in the same ratio as the two diameters of the pulleys, however long that belt drive may be.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 50.*)

The Three-Wire System.—The two-wire system has been developed into a method of wiring, through which a great saving in copper is made. The employment of this method, under the title of the "three-wire system," by the present lighting company in New York City, and its installation as the wiring of thousands of private and public buildings establishes it as an economical and practical means of distributing current for electric lighting.

The idea involved is that of making a more efficient use of the copper than would be possible in the method of employing only two wires for electric lighting, as previously described. To illustrate theoretically and practically the advantages of the three-wire system reference must be made to the general principle underlying power transmission and its relation to the pressure in volts at which it is transmitted. The principle is stated as follows:

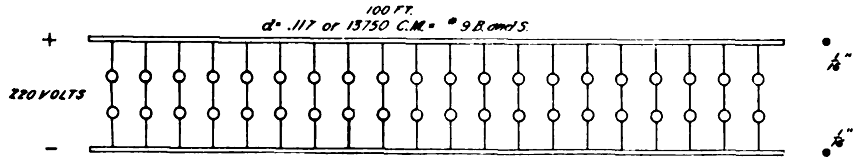
Principle.—The weight of copper required for the transmission of a given amount of power is inversely proportional to the square of the pressure. By this is meant, that if 100 hp. is transmitted at 100 volts pressure, and a certain weight, say 2,000 pounds of copper, is required, then at twice the pressure or 200 volts only one-quarter or 500 pounds of copper would be necessary. The following table is instructive in showing how advantageous it is to use high pressures for the transmission of power in comparison with low pressures as far as the saving of copper is concerned. Taking the case of 100 kilowatts to be transmitted at 100 volts over a thousand foot run the following data appears:

Volts.	Circular mils.	Kilo-watts.	Length of wire. Feet.	Weight of wire. Pounds.	Drop. Volts.
100	440,000	100	2,000	2,666	5
200	110,000	"	"	667	10
400	27,500	"	"	167	20
800	6,875	"	"	42	40
1000	4,400	"	"	27	50
2000	1,100	"	"	7	100

The remarkable reduction in the size of wire required for the transmission of 100 hp. at 100 volts and at 2,000 volts, namely, 440,000 circular mils and 1,100 circular mils, is an object lesson in finance to builders of power transmission lines. The requirements for insulation naturally increase, but the cost of erecting the wire becomes much less on account of its lightness. A heavy line requires strong sup-

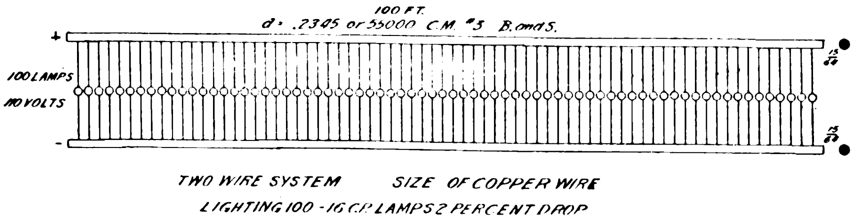
ports and great expense is involved if storms affect the stability of the line while in service. This is largely obviated where a light wire is run, that is to say, where a high pressure is employed.

The three-wire system installed by the Edison Company in the streets of New York consists of a network of copper embracing all of the downtown or business territory and following up the main thoroughfare, Broadway, with extensions to either side, thus covering an extensive area. If the three-wire system were not employed, that is, if the two-wire system were in its place at present, nearly three times as much copper would be in use to transmit the same amount of power. If, for instance, the above company has $1,000,000 worth of copper underground with the three-wire system, with the two-wire system there would be almost $3,000,000 worth installed. The principle, therefore, has immense economical and practical advantages over the two-wire and in the following explanation the facts relative to this saving will be made clear:

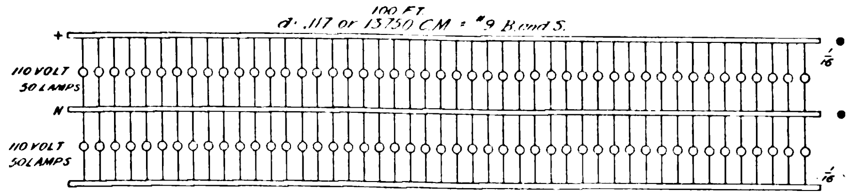


220 Volt Two-Wire System Feeding 100 Lamps in Groups of Two in Series with 2 per cent. Drop.

Suppose 100 lamps are to be lit on a 100-foot run at 110 volts pressure, then the size of wire according to the rule at a 2 per cent. drop would be 5,500 circular mils or a No. 13 wire B. & S. gauge. If the voltage is doubled then 220 volts

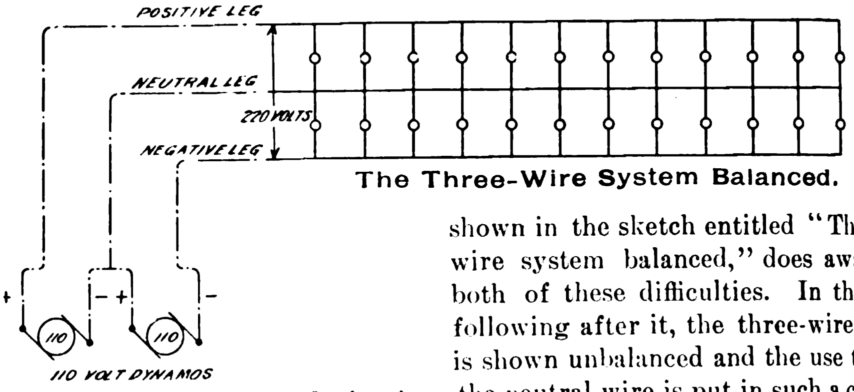


TWO WIRE SYSTEM SIZE OF COPPER WIRE
LIGHTING 100-16 C.P. LAMPS 2 PERCENT DROP



THREE WIRE SYSTEM SIZE OF COPPER WIRE
TRANSMITTING THE SAME POWER, 2 PERCENT DROP

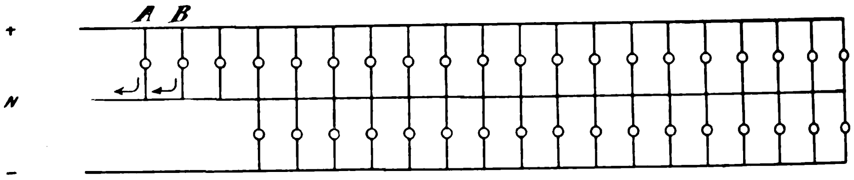
would call for every two lamps to be in series, which would mean 50 sets of lamps of two in series, requiring only one-half the current of the other circuit of lamps. The first circuit called for 50 amperes for 100-110 volt lamps on a two-wire circuit or 55,000 circular mils. The second circuit with every 2 lamps in series and 220 volts pressure, calls for only 25 amperes. The drop in the second circuit is 2 per cent. or 4.4 volts while it is only 2.2 volts in



The Three-Wire System Balanced.

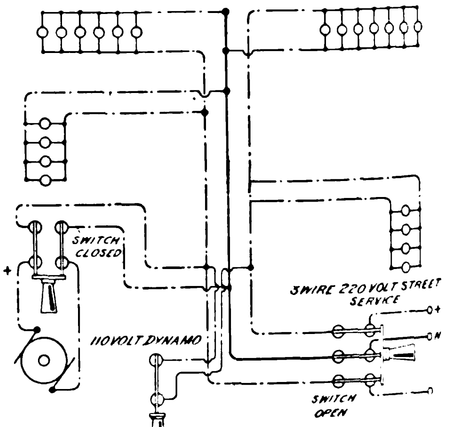
the first circuit. In the second circuit, therefore, with 220 volts pressure, not only is one-half of the current required, which reduces the circular mils one-half but twice as many volts can be lost, which reduces the circular mils again to one-half. In other words, if a 220 volt pressure is used with the lamps arranged in groups of two in series, as shown, only *one-quarter* of the circular mils and therefore the weight of copper need be employed.

But in the sketch shown, the number of lamps can be divided by 2; if one should burn out, the other connected to it would also go out, and this would make the system impracticable. Another reason why the system previously mentioned would be useless is where the number of lamps are unequal, that is, not divisible by two. The use of the neutral wire shown in the sketch entitled "The three-wire system balanced," does away with both of these difficulties. In the sketch following after it, the three-wire system is shown unbalanced and the use to which the neutral wire is put in such a case. Its function is merely to take up and trans-



The Three-Wire System Unbalanced, showing use of neutral wire with respect to Three Lamps.

mit the current of the difference between the two sides of the circuit. If the neutral wire were not employed, the amount of copper used at 220 volts, with groups of two lamps in series, would be only one-quarter, but with the neutral wire, for purposes of illustration, the same size as the two others, the amount of copper used becomes $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{3}{4}$ of what would be required to light the same number of lamps at 110 volts by the two-wire system. The exact difference in the size

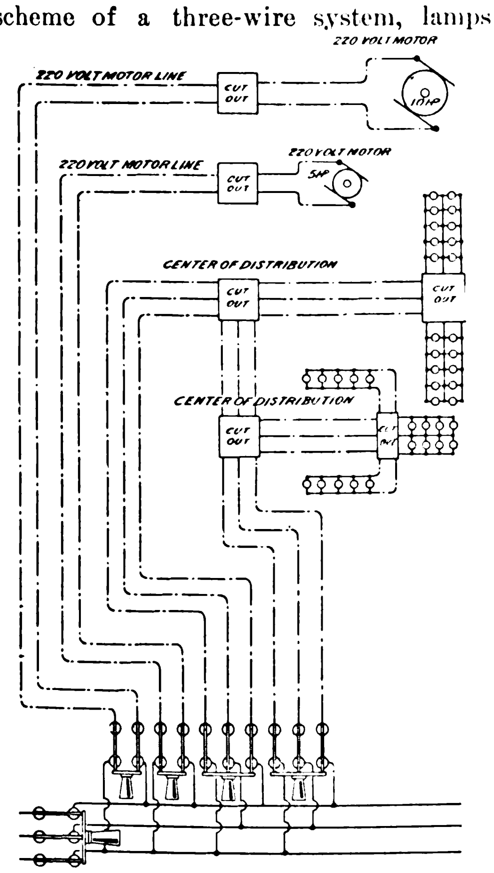


Combination Two and Three-Wire System for Protection Against Breakdown of Private 110 volt Two-Wire System.

of copper is shown by the sketches in adjacent columns both as regards diameter in inches and circular mils in cross-section.

A simple calculation for obtaining the size of wire with a three-wire system is to employ the old formula with 4 in the denominator as follows: Circular mils = amperes × length of wire in feet × 11 ÷ volts drop in line × 4, or, symbolically, $C.M. = \frac{11 \times feet \times C}{4 \times E}$. As regards

the neutral wire in the laying out of a street system, such as is employed in New York, the neutral wire it not as thick as the two outer wires but is considerably less. The reason for this may be found in the fact that the lighting company will not turn current on the premises unless the lights are well balanced, therefore the amount of current carried by the middle wire is very small and its cross-section in consequence is much less than the two outer wires. If the balance is fairly even throughout the district supplied with current, the generators connected to the circuit will carry equal loads; should a great difference of balance exist, however, the load would become very heavy on one machine to the exclusion of the other and its injury would result. If the balance is, on the average, fairly good, the saving of copper through the neutral wire being small is greater and instead of .375 of the copper being used, less will be required as compared with a two-wire system. The same general ideas are carried out in the equipment of a building for a three-wire system as for a two-wire, with the addition that particular care is taken to keep the circuits balanced. In the following illustration is shown the general scheme of a three-wire system, lamps



Three-Wire System with Two Centers of Distribution.

equally balanced, and special motor lines of 220 volts apiece. The idea can be still further carried out for a more extensive and more complicated circuit. The neutral wire in a perfectly balanced system is hardly necessary except in such cases as a few lights more are kept burning on one side of the circuit than on the other.

Combination of Two and Three-Wire Circuits.—In many instances where private plants are installed, the danger of a break-down has led the proprietor to make provision for such an emergency by having the wiring done so as to take current from the street if necessary, without risking the lamps in ordinary use. This is accomplished by equipping the building with the three-wire system but making the neutral wire of twice the cross-section of the two outer wires. By this means both a 110-volt two-wire system and a 220-volt three-wire system are combined and the equipment will work admirably on either, if the circuits are balanced. There is a distinct saving of copper by this method of wiring over the two-wire system, because according to the figures previously given, three wires, if of equal size, represents .375 of the copper which would be required in a two-wire system of equal capacity. Each wire is therefore one-eighth, and if the middle wire is twice the circular mils of the other two the total will be $\frac{1}{8} + \frac{1}{4} + \frac{1}{8} = \frac{1}{2}$, or .50. In other words, a building wired according to the above requirements is still using only one-half the copper otherwise required by a two-wire system.

In handling heavy wires it is frequently necessary to be able to calculate the weight of the wire, as for instance in considering the mains and feeders of a large installation. The formula for doing this is as follows:

Pounds per foot of copper = circular mils $\div$ 62.5 $\times$ 5,280 or lbs $= \dfrac{\text{C. M.}}{62.5 \times 5{,}280}$.

By leaving out the 5,280 the weight of copper per mile is obtained and the formula becomes: Weight per mile in pounds = C.M. ÷ 62.5. In power lines for motors or lighting this calculation is very valuable, as in the preparation of estimates many means are adopted to keep the weight of copper down.

Example.—As an example of the above, suppose 200 hp. is to be transmitted one mile at 500 volts and 5 per cent. drop, what is the size and weight of the wire?

$$\text{The circular mils} = \frac{300 \times 10{,}560 \times 11}{25}$$

= 1,393,920.

$$\text{The weight per mile} = \frac{1{,}393{,}920}{62.5} =$$

22,303 pounds for a single wire or a total of 44,606 pounds per mile.

$$\text{The weight per foot} = \frac{1{,}393{,}920}{62.5 \times 5{,}280} =$$

8.44 pounds.

The above figures are indicative of the necessity of estimating drop as high as is consistent with good engineering or the weight of the copper becomes excessive.

The law promulgated by Lord Kelvin years ago reads as follows: The cost of copper must be such that the interest on the investment shall not exceed the cost of wasted power in the line. The meaning of this is that with $100,000 spent for copper in a transmission system only $6,000 worth of power should be wasted, because this represents the interest on the investment.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

MONEY SAVED BY A WHOLESALE RENEWAL OF LAMPS DURING PEAK LOAD.

In a station having a pronounced peak load for only a short period during the holiday season, a material saving may be brought about by making a wholesale renewal of all lamps on the line, substituting lamps of a high efficiency for the short time of peak load.

Assume the station running on 3.5 watt lamps to be full loaded, so that any additional load will require additional generating and distributing equipment, it is perfectly proper, then, to credit on one side of the balance the interest and depreciation of the investment, which will be saved by a substitution of, say, a 3.1 watt lamp, for with the same equipment of station and line, it will be possible to furnish current for 11.4 per cent. more lamps, and against this must be charged the additional expense that will be incurred by the increased cost of lamp renewals for the short period.

Assume 3 per cent. regulation on the line, and the 3.1 watt lamp gives a life of 263 hours before dropping to 80 per cent. of its initial candle power, while 492 hours' life is obtained from the 3.5 watt lamp; or there is a loss in lamp life of 229 lamp hours per lamp for each substitution which is made. If a station with 42,000 connected lamps is considered, this will represent an additional cost corresponding to 9,618,000 lamp-hours, provided each 3.1 watt lamp is used to the extent of its useful life.

The cost of lamp renewals being made up of the cost of the lamp, which will be assumed at 17 cents, plus the cost of labor of photometering and changing at $1\frac{1}{2}$

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

cents per lamp, gives a total lamp renewal cost of

$$\frac{17 + 1.5}{492} = .00037$$

per lamp hour, and having lost 9,618,000 lamp-hours, the expense incurred due to additional lamp renewals would amount to $3,558.66, provided all of the useful life of each lamp were used up, or the lamps burned 263 hours each.

In the station under consideration the actual average burning of each lamp during the month of December amounts to 45 hours, so, instead of an expense of $3,558,66 for the increased lamp renewals that would be occasioned, the expense would be

$$\frac{45}{263} = 17.1 \text{ per cent. of } \$3,558.66, \text{ or}$$

$622.76, and to back against this there would be saved interest at 6 per cent. and depreciation at 6 per cent., or 11.4 per cent. of the investment of 42,000 lamps, which can be fairly taken at $10 per lamp. This would amount to an annual expense of $5,745.60 fixed expense due to interest depreciation, or by the substitution of the 3.1 watt lamp for the month there would be a net saving to the company of $4,500.80 per annum.

Another factor should come into consideration at this point, and that is that the consumer is using a smaller amount of energy for a given amount of illumination during this short period, and he is benefited during this time by having a decreased bill, to which he will raise no objection, while the station will have its kilowatt-hour sales curtailed by an amount equal to the difference in lamp efficiency, provided the consumer is paying for his current on a straight meter basis.

MADISON GAS AND ELECTRIC COMPANY.

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A TROUBLE TRANSFORMER.

It frequently happens that it is necessary to install a transformer at some point on the distributing system where the delay due to the labor of getting a transformer out of the storehouse and hanging it is a very serious matter. This may occur at the time of the burning out of one of the regular line transformers, or an exceptionally heavy demand may be brought upon some particular district, say for a day or two, which will require a considerable increase in transformer capacity over that which is normally demanded. Considerable expense and labor, as well as delay, can be prevented by having a transformer of a large capacity mounted upon a light wagon and housed in, so that it is impossible for people walking along the street to touch the transformer or lead wires.

At the station where this scheme is put into service a 60 kw. transformer is connected up with leads thoroughly insulated, which are taken out of the top of the housing covering the transformer; a locked cabinet contains the switch and fuses for both primary and secondary sides, and the transformer leads are fitted with clamp connectors of large bearing surface. In case of a transformer burnout, but a few minutes are required to back the wagon up to the pole, clamp on the connections and close the switches, the regular trouble men doing the work without the assistance of the line gang. The housing is wired on the outside, and red lamps, placed in the sockets, guard against the wagon being run into at night by passing vehicles, should it be necessary to let the wagon stand in the street over night.

W. J. HUGO, Madison, Wis.

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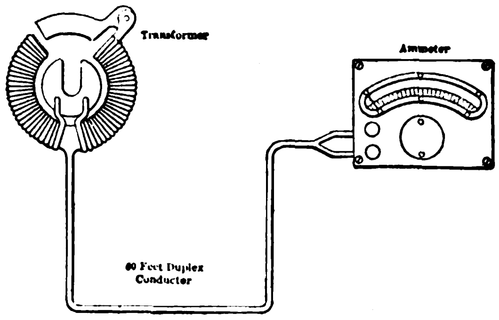
A LINE AMMETER.

The accompanying sketch represents a "line ammeter," which is one of the



METHOD OF CONNECTING AMMETER AND TRANSFORMER.

most convenient instruments that has been brought to the attention of central station operators for some time. The instrument is used to measure the current flowing in a conductor, although it is unnecessary to open the circuit to measure it. The great value of this instrument lies in its ability to determine instantaneous demands on transformers, and to determine as to whether the loads are properly balanced on the two sides of three-wire secondary network.

The apparatus consists of a series transformer wound on a two-piece iron ring, so arranged that a small segment of the ring on which there is no winding acts as a hinge to be opened and closed over the conductor carrying the current. Connected to the transformer coil is a 60-foot length of duplex flexible cable ending in terminals that fit in the binding posts of a suitably calibrated ammeter, which reads the load in amperes direct.

To operate the instrument a lineman carries the small coil—weighing about two pounds—up the pole to the secondary leads and snaps it on, while a man on the ground reads and records the amount of current flowing.

The use of this instrument is bound to show up miscalculations as to division of load, which takes place in secondary network, no matter how carefully it may have been estimated.

C. W. HUMPHREY, Denver, Col.

—

CONNECTING TWO-WIRE THOMSON-HOUSTON METER IN TWO-WIRE CIRCUIT—WHICH IS A PAIR OF THREE-WIRE SYSTEMS WITH GROUNDED NEUTRAL.

The solution of a case in connecting a two-wire Thomson-Houston meter in a two-wire circuit from an Edison three-wire system might be a wrinkle to another company operating a three-wire Edison system with neutral grounded.

The neutral wire of the two-wire circuit was connected to the series field terminal of the meter; the shunt terminal was connected to the other wire; a ground developed in the customer's premises on the neutral wire. The result was that the meter operated sometimes forward and sometimes backward.

The solution is found in testing always before connecting a two-wire meter on a three-wire system when the neutral of the three-wire system is used for shunt purposes only in the meter.

ROBERT LINDSAY, Cleveland, O.

Social Economics of the Weston Electrical Instrument Company.

The Weston Employes' Club of Newark, N. J., recently prepared a splendid publication for the St. Louis World's Fair at the request of the Bureau of Statistics of Labor and Industries of the State of New Jersey.

The book is handsomely printed, and heavy calendered paper shows up beautifully a large number of half-tones illustrating some of the social features connected with the Weston Electrical Instrument Company and a glimpse of the company's manufacturing departments.

As our readers are undoubtedly aware, the Weston plant is situated in the Waverly district of Newark, at the extreme southwestern corner of the city, on healthful grounds separated from beautiful Wee-qua-hic Park by the broad tree-lined Elizabeth Boulevard. Facing the works is a wooded triangle of considerable extent, the property of the company, which is a favorite summer resting place for the employes, while along the west side and back of the buildings is a handsome lawn of several acres. The remainder of the

property is rented for farms, but the question of cultivating it for the benefit of the club is under consideration, also a plan to set aside grounds for outdoor games.

We regret that space will not allow us to print in this issue the well-written description of the works and club rooms, but we copy a few very interesting paragraphs from the book, pertaining to the club, as follows :

"A treble purpose prompted the Weston Company in planning for the safety, the comfort, the health, the recreation, the prosperity of its employes. It might with truth be claimed that the altruistic idea was uppermost, but the company prefers to emphasize the material side of the question. All other things (such as wages, hours, etc.) being equal, the company was convinced that, if it could add thereto a sentiment, wrought into practice, of care for the welfare of the men and women in its employ, it would tend to attract and retain a superior class, who would become more than ordinarily interested in their work and would, also, promote pleasant relations between employer and employed; and that, therefore, such, commonly called, altruistic adjuncts would become financially profitable. There was a third underlying principle, more essential, possibly, to the success of the purely social features of the establishment than any other, and this was the determination of the company to exercise no paternal or patronizing control, but to create a club-plant fully equipped in every particular, and turn it over to the employes, on whom should devolve the entire responsibility of organization and administration—of success or failure.

"Pursuant to this policy the company, before planning its new works, employed two mechanical and engineering experts to visit the most notable manufacturing establishments in the United States, studying problems of construction, machinery and other physical conditions. Another expert traveled through the country for a year to learn what American employers were doing for their employes outside the mere question of wages, and when the present plant was erected the company reserved the most desirable portions of the premises, several commodious halls, furnished them as recreation room, library, kitchen, dining room, gymnasium, natatorium, bicycle depot, hospital, etc., and, at the inauguration reception the entire club outfit, with a working capital of $1,000 contributed by a director, was formally transferred to the employes, who, electing their own committee on plan and scope, soon completed the formation and incorporation of the 'Weston Employes' Club of Newark, N. J.'

THE CLUB ROOMS.

"The whole of the first and second floors of the north wing of the building, and the second floor of the east wing are devoted to the club. In the second story of the north wing, superbly lighted and ventilated on both sides, in a room 175 feet long by 35 feet wide and 16 feet high, are located the two chief features of every well-ordered club—the culinary and administrative departments, the kitchen being in an extension on the south. This hall embraces, (first) the main dining room; (second) two cabinets, inclosed about half way to the ceiling, (a) a lunch room for the executive staff (the heads of departments), and (b) a directors' lunch room; (third) a 'cosy corner,' and (fourth) the great size of the room permitting it, the library.

"The dining hall is handsomely furnished; the color scheme is pleasing—white walls, buff shades, furniture of a cherry effect, and many pictures. When the room is set for luncheon its appearance compares favorably with a high-class hotel or restaurant.

"Lunch is either table d'hote or a la carte. The table d'hote costs 20 cents, and the patron is entitled to as much of any or all the dishes as he may desire. The writer of these lines has had the pleasure of lunching several times with the Weston Employes' Club, and can affirm that few business men in New York City, who pay from 50 to 75 cents are as well served in either quality or quantity as are the employes of the Weston establishment.

"Directly under the dining hall is the natatorium, 160 feet by 35, with a 20-foot ceiling—light, bright and cheerful. The writer of this sketch labors under difficulties. He has been directed to say nothing laudatory of the company, nor to refer to its head, who is the moving spirit scientifically, mechanically and altruistically, nor is he permitted to indulge his bent in the use of adjectives; but he is compelled to say that this bath (or rather these baths) is a splendid affair. The tank, cement and enameled brick, is 150 feet long, 18 feet wide, and from 4½ to 9 feet deep. The flooring is a handsome white mosaic tiling tastefully bordered in green, with a couple of two colored marble steps, about 75 feet long, leading up to the batteries of shower and needle, and tub baths—six of each. A filtering plant is being installed.

"In the east wing, at a right angle to the dining hall and connecting therewith, is the recreation hall, 182 x 26 x 16 feet, furnished with a baby-grand piano and pianola, billiard and pool tables, chess, checkers, cribbage, dominoes and other games, fencing and boxing outfits, and the commencement of a gymnasium.

"On one of his visits to the works the writer was accompanied by a woman of broad culture, wide travel and acute observation—an educator of national reputation, and largely experienced in public life. After spending several hours in the establishment, examining every department, industrial and social, she said, 'Had I not had this practical demonstration, nothing could have made me believe that any manufacturing concern on earth was so interested in the health, the comfort, the pleasure and the general welfare of its employes.'

"This was repeated to Mr. Weston, whose simple comment was: 'We have done nothing, as yet, save to make a few rough beginnings.'"

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 26, 1904

Electric Railways and Appliances.

765,813. Car-Fender. Fred E. Caton, San Jose, Cal., assignor to Caton's Foundry and Machine Company, same place. Filed Oct. 27, 1903.

765,850. Trolley. Walter O. Miller, Louisville, Ky. Filed Feb. 10, 1903.

765,852. Trolley. Jacob M. Olinger, Vienna, Crossroads, O. Filed May 12, 1904.

765,974. Trolley-Wire Clip. Albert E. Holaday, New Haven, Conn. Filed Dec. 30, 1903.

Electric Lights and Appliances.

765,681. Shade-Holder for Incandescent Lamps. Richard W. Schmelz, Far Rockaway, N. Y. Filed Dec. 5, 1903.

Electrical Machinery and Apparatus.

765,686. Electrically-Controlled Damper for Heaters. Frank J. Sprague, Oswego, N. Y. Filed Sept. 4, 1903.

765,773. Electric Printing Machine. George S. Gallagher, New York City, assignor to himself, Rupert L. Joseph and Frank E. Burrows, same place. Filed Sept. 18, 1903.

765,948. Current-Regulator. James J. Wood, Fort Wayne, Ind. Filed Aug. 17, 1903.

765,960. Electromagnetic Typewriting-Machine-Actuating Mechanism. Edward K. Curtis, New York City, assignor of two-thirds to Sydney H. Carney, same place, and William Watt, Elizabeth, N. J. Filed Dec. 15, 1903.

766,104. System of Motor Control. Arthur C. Eastwood, Cleveland, O. Filed April 19, 1904.

Telephones and Telephone Apparatus

765,768. Auxiliary Apparatus for Telephone Systems. William W. Dean, Chicago, Ill., assignor to Walter S. McFarlan, Washington, D. C. Filed Oct. 17, 1903.

765,822. Telephone Exchange System. John P. Downs, Cleveland, O., assignor, by mesne assignments, to John F. McDonnell, same place. Filed Oct. 23, 1902.

766,155. Telephone-Repeater. David H. Wilson, Chicago, Ill., assignor to George W. Kretzinger, same place. Filed Aug. 13, 1903.

Miscellaneous.

765,922. Electric Signal System. Joseph H. Harrell, Charlotte, N. C. Filed Sept. 30, 1903.

765,926. Electrical Toy. John Kelly, Paterson, N. J. Filed May 4, 1904.

766,701. Electrical Quick-Return System. Richard H. Stevens and Samuel S. Wales, Munhall, Pa. Filed Jan. 2, 1903.

766,146. Method of Purifying Water. William M. Jewell, Winnetka, and Willford J. McGee, Oak Park, Ill., assignors to themselves and Omar H. Jewell, Chicago, Ill. Filed Jan. 26, 1903.

THE TELEPHONE WORLD.

Federal Company Clearing Up Financial Matters.

Announcements from Cleveland, O., state that the Federal Telephone Company, by the transfer of a block of bonds, reduced its liabi ities by $600,000, and later concluded arrangements for borrowing $450,000, all of which will be expended through Ohio and adjoining States, in extensions of the long-distance lines of the United States Telephone Company.

These were the most important announcements that have been made by the Federal Telephone Company since the embarrassment of the Everett-Moore Syndicate The two announcements completely change the condition of the Independent telephone situation in that part of the country, and amount to a great deal in clarifying the situation that has menaced the Federal Telephone Company for nearly three years.

The outstanding unsecured obligations of the Federal Telephone Company now amount to but $900,000, which is less than one-fourth of what they were when the company found itself in trouble three years ago.

The agreements with creditors, by which bonds of the subsidiary companies owned by the Federal, were transferred in settlement of the Federal indebtedness, have been under way from the first. President Dickson has pushed it with much vigor and has been conspicuously successful. For the first time the Federal is now where it can be said to see daylight ahead of it.

The situation, which was considered exceedingly complicated, has been gradually untangled, and matters have been put in such shape that the ultimate settlement of the whole matter can be said to be in sight.

The largest sum of money which the last arrangement leaves available for the development of the United States long-distance lines, puts that company where it can largely increase its earnings, and it is already one of the best earning properties the Federal Company owns. It makes the Federal and United States more powerful, and will make it possible for the officers to go ahead with plans they have long had in mind.

Superintendent William Bolton, who has charge of the life-saving station telephones in the district of Salisbury, Mass., with his assistant, Mr. Maxim, have been engaged looking over the ground relative to connecting the Hampton Beach life-saving station with the one at Salisbury Beach. This will fill a break between the Massachusetts and New Hampshire stations that has long been needed. It is probable that the line will be built before winter.

E. F. Sell, Paul Albrecht, William Dickmeyer, C. W. Heiman, G. A. Rieke, A. E. Fenske, Peter P. Ness, John M. Mahowald, S. W. Smith, A. E. Carver and A. V. Rieke have incorporated the Fairfax Telephone Company, of Fairfax, Minn., with a capital of $10,000.

The Gemmill Telephone & Manufacturing Company, of Orrville, O., is the name of a new concern capitalized at $60,000. James I. Gemmill, Thomas S. Dunlap, James Nicoll, Sr., L. R. Dunham and W. S. Tims are interested in the enterprise.

Telephone Men Plan Consolidation.

A meeting of the owners and managers of the Shortsville, Manchester, Clifton Springs and Phelps telephone exchanges was lately held in the office of W. H. Burke, in Clifton Springs, N. Y., and in the evening a party consisting of Oliver S. Titus and C. P. Osgood, of the Red Jacket Telephone Company; W. H. Burke and W. C. Ellis, of the Clifton Springs Telephone Company; and Adelbert Groat, of the Phelps Telephone Company; C. A. Lux, of the Wayne County Telephone Company, and W. H. Kelley, of the Newark Telephone Company, met in Newark.

At Newark plans were discussed and perfected to consolidate the different companies so far as the interchange of business between the different companies is concerned. With the consolidation it will be very difficult for a competing company to exist in any of the villages in the consolidated district. It will include 10 villages, with over 1,300 subscribers. W. C. Ellis, of Shortsville, will be the attorney of the different companies.

Petition for Telephone Foreclosure.

Suit was filed last week by the Territorial Bank & Trust Company of Muskogee, I. T., against the Commercial Telephone Company, with its principal office at San Antonio, Tex., for the foreclosure of a deed of trust and the appointment of a receiver. The petitioner alleges that on August 20, 1901, the defendant company executed a deed of trust on all its property, franchises, etc., and the amount so mortgaged was not to exceed $1,000,000, and that subsequently bonds were issued and sold by the defendant company.

The annual meeting of the directors of the Seneca-Gorham Telephone Company was lately held at Stanley, N. Y., and the annual report shows the concern to be in a prosperous condition. A 6 per cent. dividend was declared and plans were discussed for the extension of the lines. The capital stock was increased from $10,000 to $30,000. The company has now 60 miles of toll lines. The election of officers resulted as follows: President, John A. Driscoll, of Rochester; vice president, Dr. D. S. Allen, of Halls; secretary and treasurer, Rice Macauley, of Stanley; auditor, Dr. D. A. Allen, of Gorham. The lines are to be extended to Bellona.

B. L. Freedy, for the past 10 years St. Paul Minn., manager of the Northwestern Telephone Company, has been named as superintendent with headquarters at Minneapolis. R. H. Woolfolk, manager of the Stillwater exchange, succeeded Mr. Freedy in St. Paul, and C. P. Donnellan, assistant general manager of the St. Paul exchange, went to Stillwater, to take the position made vacant by Mr. Woolfolk's promotion.

The Wisconsin Telephone Company will expend $50,000 in building and equipping the new exchange at Green Bay.

The Youngstown, O., Telephone Company has increased its capital stock from $200,000 to $400,000.

The Oldham, Ky., Telephone Company has increased its capital to $20,000.

Growth of Telephone Lines in Southern Country.

The American Telephone & Telegraph Company has undertaken a campaign of marked long distance telephone extension in the South, and anticipates covering Cuba with its lines.

The building of two lines into Meridian, Miss., will be started at once. One is to come from Birmingham southwest to Meridian, a distance of 150 miles, the second from Mobile north to Meridian, about 140 miles. The long-distance lines of the Cumberland Telephone & Telegraph Company, already connect with Meridian. The new line will give direct communication with Chicago, St. Louis, Richmond, Atlanta and other cities.

Two hundred men are employed in building the new lines. The long-distance line will connect with one of the exchanges at Meridian, probably the new Independent company, being organized with Chicago and local financiers, to have a capital of $100,000. From Meridian the the American Telephone & Telegraph Company will likely cover the State with its lines.

That it is the intention of this company to cover the Island of Cuba with long-distance lines is evidenced by the fact that its crews of right of way men and engineers have just been over the principal parts of Cuba to determine upon the matter.

The Home Telephone Company, which has maintained an exchange in Pavilion, N. Y., is soon to consolidate with the Le Roy exchange, which will do away with toll rates between the two villages. Hitherto it has cost 15 cents to talk from Le Roy to Pavilion. It will be a move much appreciated by the subscribers of the company.

The White & Davis Telephone Company of Columbiana, Ala., with a capital stock of $10,000, has been incorporated by J. R. White, W. F. Davis, W. P. White and N. Davis. Lines are to be built in Shelby County.

The Topeka, Kan., Independent Telephone Company has received from the board of education the contract for telephones for the schools in Topeka.

The China Telephone Company, of South China, Me., capitalized at $10,000, has been formed with the following officers: President, W. S. Thompson, South China; treasurer, F. B. Foye, China.

Business men in Edinboro, Pa., have organized an Independent telephone company. Application has been made for a charter of incorporation.

Telephone Incorporations.

The Himrod Telephone Company, Himrod, N. Y. Capital stock, $2,000. Incorporators: C. M. Van Dyke, E. F. Porter, H. S. Voorhees, all of Himrod.

The Sherman & Nole Eddy Telephone Company, Hale Eddy, N. Y. Capital stock, $7,000. Directors, John Thomas, N. N. Gordiner and Fred Kingsbury, all of Hale Eddy.

The Cedarville Home Telephone Company, Chicago, Ill. Capital stock, $7,000. Incorporators: S. W. Roberts, H. M. Fisk and S. F. Newhall.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Batesburg, S. C.—The electric light and waterworks commission have contracted with Frederick Minshall, of Abbeville, for the construction of water and light plants for this town, for an amount not exceeding $18,500. Six months is the time required for the completion of contract.

Camden, N. J.—On recommendation of Chief Engineer Hollingsworth, of the water department, the water committee of city council has decided to install an electric lighting plant at the Morris Station waterworks, to cost about $2,200.

Camden, N. Y.—Announcement has been made by the electric light commission that it has decided upon a site for the new municipal electric lighting plant. Promise is made that the plant will be in operation this coming winter.

Canajoharie, N. Y.—The Montgomery County Electric Light & Power Company's plant was recently destroyed by fire.

Chicago, Ill.—A new electric lighting station is being planned by City Electrician Ellicott at Fullerton avenue and the North Branch of the Chicago River.

Dixon, Cal.—E. D. N. Lehee, the manager of the Dixon Light & Water Company, is making preliminary arrangements for installing an electric light and power plant in the town of Winters.

Enterprise, Ore.—The electric light plant and planing mill here were lately destroyed by fire. The loss on the electric light plant was $5,000.

Fairmount, Ill.—W. S. Thompson, of Fithian, will start an electric light plant here.

Far Rockaway, N. Y.—Residents of the Wave Crest section of this village are desirous of having their roadways lighted, and have started a petition asking that electric lights be furnished. The Citizens' Improvement Association will also take up the matter.

Kissimmee, Fla.—An issue of $25,000 municipal electric light and power plant bonds has been authorized by popular vote.

Lebanon, Ky.—A new electric light and power plant is to be installed here.

Lewisburg, Pa.—Through the liberality of friends an electric light plant is being installed at Bucknell University. It is expected that the plant will be ready for use at the opening of the fall season, September 22.

Logansport, Ind.—The amount of $30,000 is to be spent in improving the electric lighting plant here.

Loretto, Pa.—Charles M. Schwab has informed this borough council, his boyhood home, of his decision to pave the village streets, underlay them with sewer and water mains and build a waterworks and electric light plant at a cost of $1,000,000. He stipulates that the citizens shall build brick sidewalks and maintain the plants.

Springfield, Tenn.—Granberry Jackson, engineer in charge of the building of the water and electric light plant, has furnished to the building committee plans and specifications, and as soon as the same are approved contracts will be let with the intention to finish the plants by December 1.

Spring Valley, Wis.—This city has adopted plans and specifications for a municipal electric lighting plant to cost about $10,000.

Wilburton, I. T.—Contracts have been signed between this city and James Degnan for a $50,000 electric light plant.

Winthrop, Minn.—At a coming election the question of issuing bonds to the amount of $7,000 for enlarging the electric light plant, will be voted upon.

Woodville, Ala.—The citizens will vote on a proposition to issue $7,500 worth of bonds to be used in constructing a waterworks and electric light plant.

Wrightsville, Ga.—At a recent special sitting of the superior court, Judge Daley granted the charter for the Wrightsville Electric Light Company. The officers of the company are: A. T. Cobb, president, William W. Cook, secretary and treasurer.

STREET RAILWAYS.

Auburn, Me.—An electric road is proposed from here to Turner. A corporation known as the Auburn-Turner Electric Railway Company, has been formed with Harry Manser, judge of the Auburn municipal court as president; E. S. Hill, of Boston, as treasurer, and A. L. Kavanagh, of Lewiston, as clerk. These men with four others, who will be Turner citizens, will constitute the board of directors.

Baxley, Ga.—Steps are being taken for the construction of an electric railway from here to Reidsville. Dr. Comas, of this place, is interested.

Bay City, Mich.—The Bay City & Caro Electric Railway Company has applied for a franchise for a road to Caro.

Bonham, Tex.—The McKinney, Bonham Interurban Electric Railway Company is completing arrangements for the immediate construction of its new road.

Carrollton, O.—James White, of Steubenville, has been granted a franchise to build an electric railway along Main street.

Chattanooga, Tenn.—S. W. Devine and associates, promoters of the Cleveland & Ducktown Electric Railway, have employed a local civil engineer to begin preliminary surveys for the proposed road.

Harrisburg, Pa.—The Trapp & Limerick Electric Railroad Company will extend its lines.

Jackson, Mich.—William A. Boland is the promoter of a new electric line from here to Lansing.

Kalamazoo, Mich.—G. A. Mullins is interested in the new Kalamazoo & Lake Shore Traction project.

Madison, Wis.—By the time the Madison-Janesville Interurban Railway becomes a reality a connection between Racine and Lake Geneva will have been perfected, according to present indications; and as Janesville is already joined to Beloit and Racine to Chicago, it will be possible for the Madison tourist to make the entire trip to Chicago by trolley.

Monroe, Wis.—George W. Bowman has petitioned the council for a 20-year franchise for an electric street railway. It is a part of a projected system of 83 miles of track, reaching out six miles into the country in four directions.

Newark, N. J.—Plans are under way for the construction of a trolley line from this city to Morristown, eventually to be continued to Easton, Pa. The company will be known as the Lehigh Valley Traction Company, and is composed largely of Pennsylvania capitalists. The route will be one surveyed 30 years ago for the New Jersey Central Railroad. From Morristown it will run through Afton, Hanover, Moorehouse Town and Livingston.

Norfolk, Va.—Notwithstanding the litigation which was begun in New York and this city by the stockholders of the Chesapeake Transit Company, progress is being made to convert the two roads involved in the merger into electric lines.

Racine, Wis.—Mayor Nelson is in correspondence with Boston capitalists who desire to build an electric railway line from this city to Lake Geneva.

Titusville, Pa.—Representatives of the Titusville Traction Company are securing the right of way along Oil Creek.

Wilmington, Del.—Announcement was recently made that the entire right of way had been secured for the new Delaware Suburban Railway Company, which will construct a trolley line between this city and Elkton, Md., by way of Marshallton and Newark, and that work will be commenced very soon. The total length of the road at present will be 20 miles, but it is expected that the line will be eventually extended to Oxford, Pa.

POWER PLANTS.

Adin, Cal.—This town is to have a power plant. A company has been formed and made arrangements to place a power plant on a mountain stream near here, and from this point will furnish electric lighting.

Logansport, Ind.—Plans for the new power plant of the Ft. Wayne & Wabash Valley Traction Company are being made.

Mt. Angel, Ore.—The Union Light & Power Company has been granted permission to erect and place along the country roads high tension transmission lines for the transmission of electric power and energy from its power plant on Silver Creek to this place.

Salinas, Cal.—Articles of incorporation of the Vantana Power Company, with a capital stock of $500.000, were lately filed. C. P. Bradford, of San Francisco; W. E. Bradford, of San Jose; F. L. Ordway, C. V. Howard, of Monterey; F. C. Richardson, C. M. Howard, of Pacific Grove, and H. S. Bradford, of Evergreen, are the directors The company proposes to build a large dam at the junction of the Vanta Creek and Big Sur River, 40 miles south of Monterey, and to generate electricity for Monterey.

BIDS WANTED.

Burlington, Vt.—Sealed proposals, in triplicate, will be received until 12 M., August 12, 1904, for construction, plumbing, hot water heating, gas piping and electric wiring of additions to hospital at Fort Ethan Allen. All information furnished on application. The United States Government reserves the right to accept or reject any or all bids, or any part thereof. Envelopes containing proposals to be indorsed "Proposals for Additions to Hospital," at Fort Ethan Allen, Vt., Captain T. B. Lamoreux, quartermaster.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, $12\frac{5}{8}$@$12\frac{3}{4}$c.; Lake $12\frac{5}{8}$@$12\frac{7}{8}$c.; casting, $12\frac{3}{8}$@$12\frac{1}{2}$c.

Commercial failures last week in the United States numbered 220, compared with 231 and 225 in the two preceding weeks and 190 in the corresponding week last year.

A meeting of the stockholders of the West End Street Railway Company of Boston will be held Wednesday, August 10, to act upon an increase of the capital stock by 3,000 shares.

Stone & Webster have sent out circulars to the stockholders of the Houston (Tex.) Electric Company announcing that the semi-annual dividend of 3 per cent. upon the preferred stock has been passed.

The Pittsfield Electric Street Railway Company has petitioned the Massachusetts Board of Railroad Commissioners to increase its capital stock from $200,000 to $300,000 to pay for additions and extensions.

A Philadelphia syndicate, represented by Wolf Bros., has obtained control of the projected belt line around the City of Baltimore, as well as one of the principal electric roads running into the heart of that city.

The directors of the Cambridge (Mass.) Electric Light Company have increased the dividend on that company's stock from a 6 per cent. to an 8 per cent. basis. The last public sale of the stock was $205 a share.

A director in the Philadelphia Electric Company estimates that this year's surplus will be nearly $1,000,000 and that the dividend rate may be increased next year. The company has been retiring some of its bonds.

Contracts aggregating $500,000 have just been let for the construction of an electric railroad from Garrett, Pa., to Frostburg, Md., 25 miles. The company will eventually be operating a passenger line from Johnstown, Pa., to Cumberland, Md.

Metropolitan Street Railway of New York had a volume last week of about 106,000 shares and a maximum advance of $2\frac{5}{8}$ per cent., and closed at a net gain of $1\frac{3}{4}$ per cent., while Third Avenue Railroad stock, on small transactions, declined 3 points and closed at the lowest.

The Chicago Union Traction reports for 11 months ended May 31—gross $7,784,607, net $2,252,010, charges $2,086,024, surplus $165,986. For the year ended June 30, 1903, the company showed a deficit of $212,615, which makes an increase in surplus for 11 months of $378,601.

The New York Central & Hudson River Railroad Company is reported to be negotiating for the purchase of 476 miles of trolley lines in New York State, including the Albany & Hudson, the Schenectady, the Utica & Mohawk Valley, the Syracuse Rapid Transit and the Buffalo International railways.

Added to the troubles of the New York, New Haven & Hartford Railroad is the demand of employes of the New Haven street railway system for a $12\frac{1}{2}$ per cent. increase in wages and a readjustment of their runs. The Consolidated Railway Company bought the trolley line three months ago for $5,000,000.

Wall Street was full of rumors on Monday that the long-talked of deal between the Metropolitan and Interborough of New York was sure to be announced very shortly, and energetic use of the rumors advanced the tractions. In some quarters it was said that the understanding between the two Manhattan Borough companies had gone as far as written agreements between the parties concerned.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Aug. 1
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	$150\frac{7}{8}$
Metropolitan Street Railway	120
Metropolitan Securities	$89\frac{3}{4}$
Ninth Avenue	195
Third Avenue	$122\frac{1}{2}$
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	$51\frac{1}{4}$
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	67
Philadelphia Traction	$98\frac{1}{2}$
Union Traction, $17.50 paid	$54\frac{1}{8}$
Boston.	
Boston Elevated, full paid	$148\frac{3}{8}$
West End Street, com	91
do. do. do. pref	112
Chicago.	
City Railway	168
North Chicago	71
Union Traction, com	$4\frac{3}{4}$
do. do. pref	29
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	42
do. do. pref	75
Electric Lead Reduction	$\frac{3}{4}$
Electric Vehicle, com	9
do. do. pref	14
Westinghouse, com	158
do. pref	190
General Electric	$162\frac{1}{2}$
Boston.	
Edison Electric Illuminating	248
General Electric	$162\frac{1}{4}$
Massachusetts Electric Companies, com	$17\frac{1}{4}$
do. do. do. pref	$69\frac{7}{8}$
Westinghouse Electric & Mfg., com	80
do. do. do. pref	$93\frac{3}{4}$
Chicago.	
Chicago Edison	144
National Carbon, com	$29\frac{1}{2}$
do. do. pref	$104\frac{1}{2}$
Philadelphia.	
Electric Company of America	$8\frac{7}{8}$
Electric Storage Battery, com	61
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	$134\frac{3}{4}$
Western Telephone Company	$12\frac{3}{4}$
New England Telephone Company	125
New York.	
American Telegraph & Cable Company	91
Commercial Cable Company	180
Mexican Telephone Company	$1\frac{1}{4}$
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	88
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..
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ELECTRICITY.

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EDITORIAL NOTES.

The Limits of High Pressure in Power Transmission.

The early experiments of Marcel Deprez in power transmission were initiated for the purpose of discovering whether electric power could be successfully transmitted over a long line with sufficient economy to bring it within the field of practical engineering accomplishments. In this respect Deprez, the father of electric power transmission, was successful, and the history of subsequent experiments, extending over a period of nearly three decades, shows the removal of this problem from the domain of pure science or experimental research to that of a recognized department of electrical engineering.

Deprez's experiment was crude—the line short and the voltage low. Since his time the tide of high pressures has risen to enormous values and the length of line over which power can be successfully transmitted extended beyond 100 miles.

At the last meeting of the National Electric Light Association a paper was read describing a transmission plant of 5,000 kilowatts, 100 miles in length, operating at a pressure of 60,000 volts. The spontaneous sparking distance in air of an effective sinusoidal discharge of this pressure is about 5 inches, at 80,000 volts 7 inches, at 100,000 volts 10 inches and at 150,000 volts 15 inches. It has been noted by Steinmetz that the sudden opening or closing of a switch in high tension plants is a frequent cause of destructive discharges before which insulators and insulation as it were become temporarily worthless. If this is the case we begin to realize that the limits of high pressure transmission are being reached.

The high tension plant at times develops other unique characteristics. An engineer examining a Western plant states that at night while a mist clung to the mountain side he saw emanations from the wires in the form of luminous discharges which radiated to a distance of over two feet from the power lines.

The transformers are also difficult to design with reference to pressure and economy and call for direct experience in high tension lines. The lightning arresters if ineffective would be a constant menace to life and property, and at present it must be said no arresters are built to stand these enormous pressures. A group are generally connected in series.

The double or triple petticoat insulator, the wooden pole, the ordinary forms of lightning arrester, must undergo reconstruction. When pressures of 100,000 volts and over are to be employed on power lines, and they must be employed if power is to be economically transmitted over the distances in prospect, which exceed 100 miles. we may expect radical changes in lightning arresters and insulating methods or admit that the limits of high power transmission have actually been reached.

* * *

Demand for Machinery in Mexico.

Recent advices from Mexico call attention to the fact that the industrial development of that country along all lines during the past five years has been wonderful. The main sources of supply are the United States, Germany and to a lesser extent Great Britain. Contracts are continually being made for apparatus for the transmission of power for factories, electric lighting, irrigation, and mills of all kinds, and there is not a city or town of any importance throughout the Republic that is not sharing in the solid and substantial progress.

The demand for mining and reduction machinery, as well as for electrical ma-

chines and appliances, has more than doubled itself within the past two years, and the expansion of the great railroad systems, now aggregating 10,000 miles, has brought about a rapid development of new industries, which in turn have created a large and growing demand for almost every kind of machinery.

The field of development in electric lines alone is enormous. In a country like Mexico, where the cost of fuel cuts deeply into the profits of a manufacturer, the demand for electrical power is growing rapidly. Every town and village of any pretension is clamoring for the introduction of electricity, and the powerful waterfalls which abound in every State of the Republic are being harnessed for the purpose of generating electrical power. The demand for electrical supplies of every variety is consequently permanent and steadily increasing.

* * *

Massachusetts Street Railways Up-to-date.

The Board of Railway Commissioners of Masssachusetts in its recent report attributes the decrease in the number of surface car accidents in that State largely to the adoption by the street railway companies of up-to-date and improved safety devices. One of the most important of these, according to the commissioners, is the arc headlight which brilliantly illuminates the track for a long distance in advance, enabling the motorman to avoid collisions. It also becomes an object of such glaring prominence in all the surrounding landscape that no one can be unaware of the approach of the car at night. It is more effective as a prevention of accidents that any warning signal yet devised

Perhaps next in importance among the newer safety appliances is the whistle, which is now coming to be generally employed in place of the bell on cars which are equipped with air-brakes. A whistling apparatus upon any other than a car with air-brakes seems to be impracticable. The air-brake is, however, now regarded with such very high favor by progressive street-car managers that the time appears to be not far distant when all trolley lines on which cars run at high speed will have air-breaks on all their cars, as a measure of economy, if for no other reason.

The question of employing a system of block signals on street-car lines, similar to those which have been adopted with such good results on all the principal steam-car roads, is now under very energetic discussion in Massachusetts. Progressive street-car magnates are extremely alive to the importance of doing in some way what is done by the block signals. Unfortunately, according to the Board of Commissioners, no satisfactory system suitable for electric-car service has yet been proved to be in existence. The trouble is that the electric current used in moving the cars is liable to interfere with the current employed in operating the signals. Inventors have been for some time hard at work on schemes for overcoming this difficulty.

On all the best-managed interurban roads in Massachusetts cars are now run in accordance with orders from the central offices transmitted through telephones. At each turnout on a single-track road, if it has up-to-date equipment, there is a telephone station. Within the past few months very many such telephones have been inclosed in booths. This method is analogous to that in use on all first-class steam roads, where trains are run according to orders telegraphed from headquarters.

Finally, the very latest applied invention of an important kind for securing safety is an instrument by means of which the dispatcher at the central office can almost instantly shut off the power all along the line, including every branch line, in case he learns that some one has blundered, and that, therefore, a collision is imminent. So near perfection has the present system of information at and control from the central office been brought that the dispatcher comes very near to knowing where all his cars are throughout the most extensive street-railway system at each moment of time.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The conferences between Harvard and Massachusetts Institute of Technology officials as to a basis for any sort of a union have ended without any agreement.

The United States Navy Department will send a delegate to the International Electrical Congress.

The General Electric Company has decided to install a wireless telegraph system between its Schenectady and Lynn plants.

The special Board appointed by President Roosevelt recommended that all wireless telegraph stations on the coasts, insular possessions and the Panama Canal zone, be put under control of the navy.

In a decision recently handed down in favor of the Edison Electric Illuminating Company, Justice McCall, in the Supreme Court of this city, held that switches, wires and meters furnished by the company to individuals and corporations for their use could not be classed as real estate by the Commissioners of Taxes and Assessments.

The Keystone Electric Company of Erie, Pa., has formed an alliance with the Burke Electric Company, a New Jersey corporation of which James Burke, a well-known inventor and electrical engineer, is the president.

Articles incorporating the Automobile Racing Association have been filed at Buffalo, N. Y. The objects of the association are to encourage racing and to carry on automobile expositions.

The contract for the first isolated electric lighting plant ordered by the Provincial Board of the Philippines has been placed and will be installed by Henry D. Wolf, the electrical contractor, of the Board of Bulacan, Province of Malolos. Numerous other large orders for electrical equipment have been received in New York from the Philippines, the largest being for an extensive plant in Manila.

New York's new subway will not be absolutely finished for several months, but it will, in all probability, be opened to the public in September. It will not be operated for the public this month, but train operations will be started soon to get forces in order and perfect signaling arrangements. The great dread of the subway managers is that concerning any possibility of accident until the machinery is working perfectly. This subway has been built for rapid transportation, and may be dangerous in the initiative stage before signals and men get to working perfectly.

Exports of electrical machinery from the United States for the month of June, 1904, show a gain over the corresponding month last year. The total value of such exports for the month named amounted to $973,098 as compared with $736,597 for June, 1903.

According to a recent report, the mica mines of Colorado promise more riches than gold for that State. The mica there is claimed to be the finest and best for commercial purposes, especially in electrical manufacturing, in the world.

SCENES AND EXHIBITS AT THE ST. LOUIS EXPOSITION.

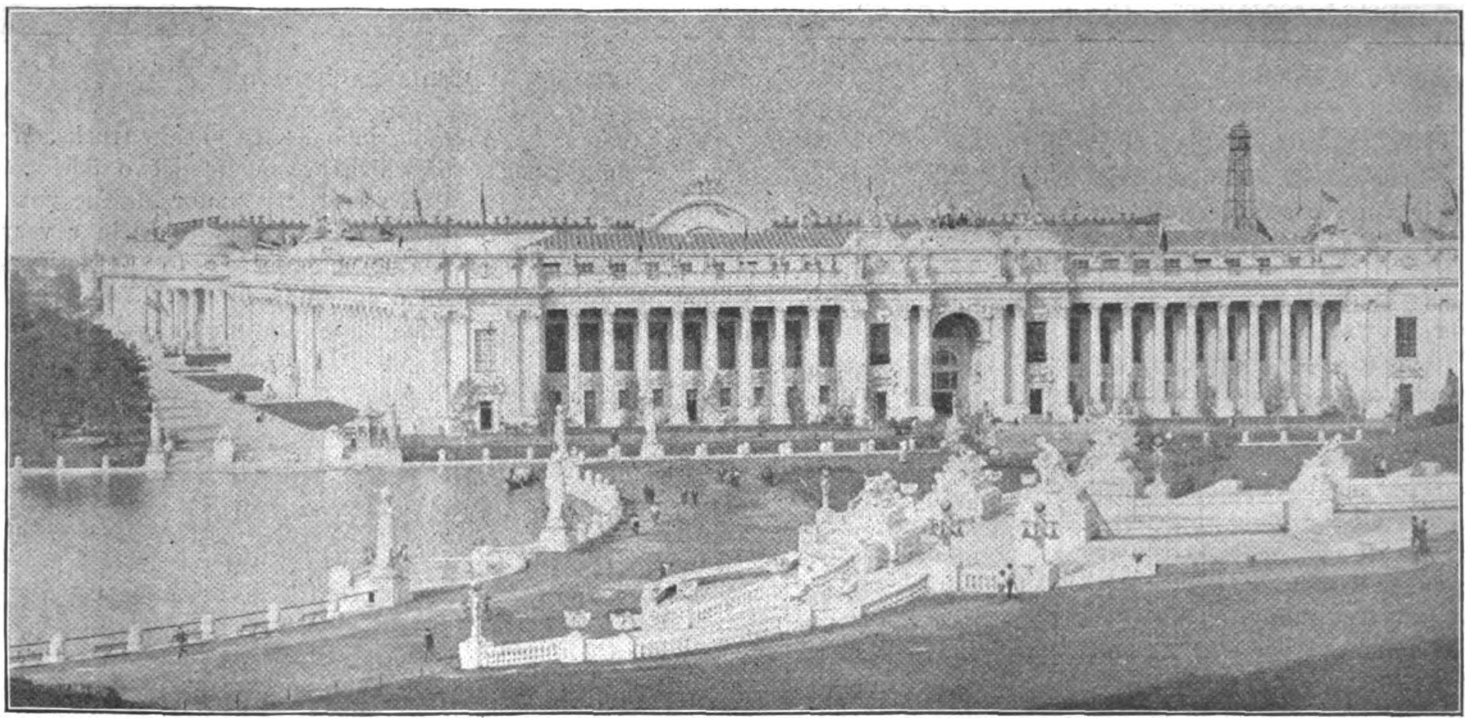
BY FRANK C. PERKINS.

Among the more important of the 15 great exhibit palaces of the Exposition should be mentioned the Palace of Education and Social Economy, which occupies a conspicuous position in the center of the main picture fronting west on the Grand Basin, at the foot of the east approach to the Terrace of States and Art Hall. This building is entirely surrounded by lagoons, but entrance is gained by means of artistic bridges from the main avenues to the corner pavilions of the palace and to the central arches. This building contains the general exhibits of the Departments of Education and Social Economy, and the displays of the technical schools and colleges of the United States as well as the foreign Governments are most interesting. The electrical and mechanical equipments of the technical schools, which are shown, include those of Cornell University, Johns Hopkins University, Massachusetts Institute of Technology, Purdue University, Rensselaer Polytechnic Institute, as well as the Universities of Chicago, Michigan and other important institutions having courses in industrial arts and sciences, such as the Pratt Institute of Brooklyn. A most extensive exhibit of equipments of the technical colleges in Germany, Great Britain, Italy, Japan and other foreign countries is installed in this building, which is 525 feet wide and 750 feet long, covering about seven acres. Many of the exhibits of scientific apparatus of the foreign countries properly belonging to the Palace of Education have been installed in the Palace of Electricity, including many laboratory equipments. In the Palace of Electricity there is a most complete exhibit of apparatus and instruments for the Educational Laboratory of the German Government installed largely by the Vereinigte Fabriken fur Laboratoriumsbedarf of Berlin. These manufacturers of scientific, chemical and electrical laboratory apparatus show some most interesting electrical furnaces and heating appliances, using a new heating substance known as "Kryptol." This is a granulated resistance material, which when inserted in the electric circuit will be heated and will produce any temperature up to 2,500 degrees C. To apply this material, Kryptol, it is placed in the heating apparatus or spread out on clay or enamel plates and according to the thickness of the layer of material and the intensity of current applied the temperature may be changed at will. It is, therefore, possible to produce different temperatures at different points of the same surface. The Kryptol substance holds the heat for a long time, so that large furnaces do not need to be supplied continually with electric current, and this means an appreciable saving of electric energy in chemical and electrical laboratories. It is stated that a great advantage of the Kryptol heating apparatus is that platinum or metallic wire or foil are avoided, and no heating material can burn through, so that no expensive repairs of the heating apparatus are necessary, and it makes little difference whether direct current is employed or single phase or polyphase alternating current.

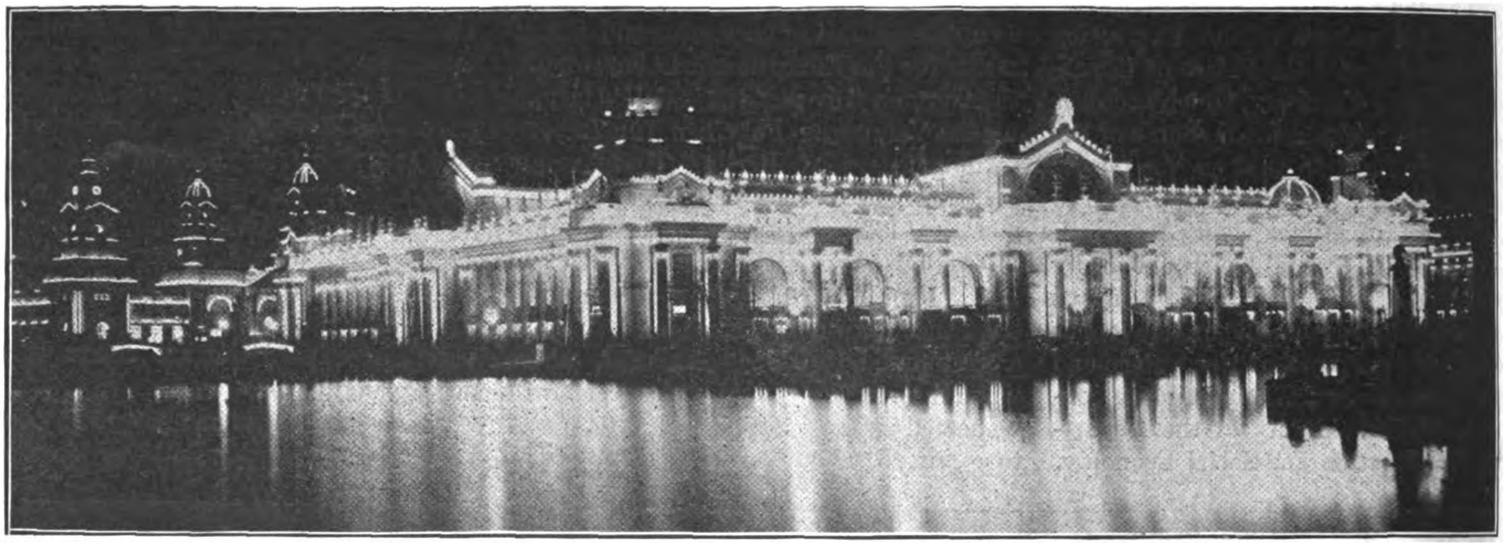
Among the interesting foreign exhibits in the Electricity Building, should be mentioned that of French wattmeters and measuring instruments of the Compagnie Anonyme Continentale Pour la Fabrication des Compteurs a Gaz et Autres Appareils of Paris, also the exhibits of direct and alternating current arc lamps of both the open and closed type as shown by the Deutsche Gesellschaft fur Bremer-Licht of Nehein, a.d., Ruhr, Germany and L. Bardon, of Cliche on the Seine, France. The connections of these lamps and the details of construction are shown in the accompanying drawings.

Among the important American exhibits in the Electricity Building should be mentioned that of the Bullock Electric Manufacturing Company of Cincinnati, O. This interesting exhibit is 104 ft. long, and 54 ft. wide, in the center of which is erected an ornamental pavilion handsomely and comfortably furnished. The Bullock motors shown in this display were designed to meet the demand for machines of small capacity to successfully withstand the rough usage to which this class of machinery is usually subjected. The yoke is of cast steel cylindrical in form, the pole pieces being built up from thin steel punchings bolted to machined surfaces on the frame. This insures a perfect magnetic field circuit, with accurately spaced pole pieces, which is rarely attained with other methods of construction.

Modern practice dictates the electric drive; it is economical, clean and renders

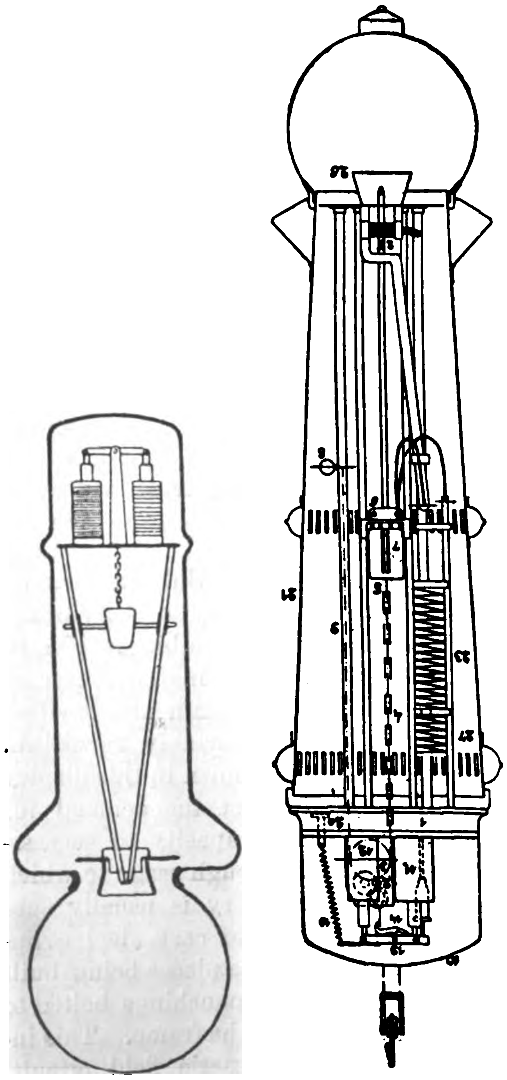


Educational Building, St. Louis Exposition.



Electricity Building, Machinery Building in distance, St. Louis Exposition.

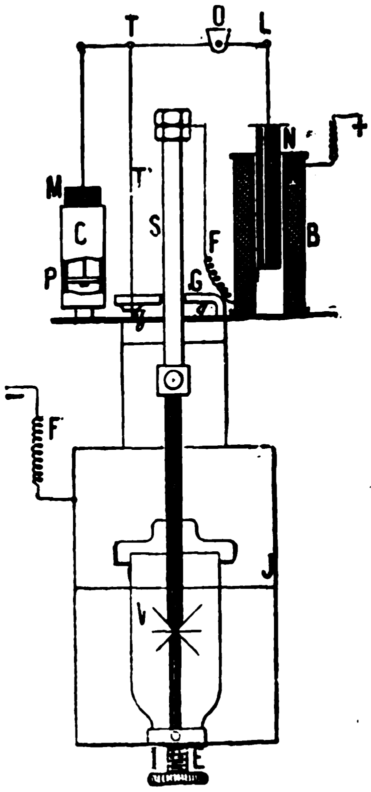
the system extremely flexible. The uses to which the electric motor can be put to advantage are legion. Nowhere is this so patent as in the machine shop. Motors direct connected to machine tools, requiring variable speeds, and operating on the multiple voltage system, have created a



Bremer Arc Lamps, Used in Lighting the Open Cupola of the German Building, St. Louis Exposition.

new era in machine shop practice. The practical operation of the Bullock multiple voltage system is shown by a complete outfit. This includes the main generator furnishing current at 250 volts, and a balancer which splits the voltage into 90 and 160 volts. An engine lathe, a milling machine, a boring mill and a shaper all direct driven by Bullock type "N" motors are operated by this set. This gives three fundamental speeds, and by the proper insertion of shunt field resistance we obtain 12 speeds in the forward direction and 9 in the reverse. The type "Y"-1 controller used in connection with this system is so constructed that a careless operator cannot stop the handle between voltages.

The five alternating current generators on exhibition range in size from 50 to 350 kw. An interesting feature in the design of these alternators is that the magnetizing coils of the field are made of strip copper wound on edge. This permits as high peripheral speeds as is possible for steel wheels without windings. The principle advantage of this method, it is claimed, is the superior ventilation. The heat developed in the wires of an ordinary bobbin near the inside has to travel through the insulation which offers a considerable resistance to the conduction of the heat. In the coils wound on edge the heat is conducted to the surface of the copper, which is a good conducting medium, and from there it is radiated out into space. The design of the 100 kw. synchronous motor generating set is said to be a singularly successful one. A large number of these have been installed, all operating on water and steam power plants without hunting. These sets are provided with oscillators, which prevent the formation of grooves on the commutator, thus greatly prolonging its life. It also insures cool operation of the bearings. The impetus which has recently been given to the building of electric street car lines, both city and interurban, has aroused a fresh interest in the design of street car motors. The Bullock exhibit includes two heavy trucks, on each of which are mounted two 50 hp. Bullock street car motors. The yokes of these motors are designed in a very ingenious manner so as to afford the maximum amount of ventilation, and at the same time prevent the entering of any



French Inclosed Arc Lamp Exhibited in Electricity Building, St. Louis Exposition.

dirt or dust. A small opening in the yokes provides for the escape of the heated air. A distinctive feature in the design of these motors is the ease of inspection and facility for making repairs. Should it become necessary to inspect or repair the lower half of the yoke or re-

move a field coil, it can be done without disturbing the armature. This is accomplished by supporting the armature in the upper half of the yoke by cap screws screwing into the bearings passing through the busings and bearings on the armature shaft. With the yoke split open and the armature resting normally in the lower half, the upper half can be similarly inspected or repaired.

These motors are supplied with current at 500 volts furnished by the 500 kw. Bullock Railway Rotary Converter. The structural details of the rotaries are substantially those which distinguish the most modern direct current machines. The poles are of cast steel snd are designed with extended tips which distribute the magnetism over a greater number of armature teeth, thus reducing the iron and heating losses of that part of the circuit, and it is claimed this also improves the commutation.

Alternating current is obtained from the Bullock 3,500 kw. 6,600 volt generator installed in Machinery Hall, and is transformed down in a Bullock 150 kw. oil-filled, self-cooled transformer. There are three of these transformers to be seen in the exhibit. The case of the transformer is made of corrugated sheet steel, which makes it considerably lighter than if it were made of cast-iron, as is usually the custom, and a larger quantity of oil can therefore be used, which will add materially in dissipating the heat.

Exhibit of the Bullock Electric Mfg. Company, St. Louis Exposition.

ARTIFICIAL LOADS FOR THE DISSIPATION OF ELECTRIC POWER.*

BY F. H. DAVIES.

Of all central station auxiliary apparatus that is not generally included in the main contract, the artificial load is, perhaps, the most important. In the days of small sets and more or less haphazard methods it was not given much thought. Some electricity works boasted sets of large and expensive resistance frames, which, constructed of steel tape or large slabs of some resistance material, were capable of dealing with 50 kw. or so, and the rest had recourse to the homely tub fitted with two lead plates and filled with a saline solution of some sort. The resistance frame for dynamo testing has had its day, but the tub in series-parallel arrangements still exists in a surprisingly large number of electricity works. With the comparatively large sets in use at the present day an artificial load is an obvious necessity, and it is safe to say that due regard to reliability and freedom from risk necessitates the trial running of a set at something approaching full load for at least a few minutes after a repair of anything but a trifling nature has been performed on it. More especially is this the case in alternating works, owing to synchronizing difficulties. In direct current stations it is often customary, say, after a bearing has been remetalled, to put the machine on load, at the same time watching carefully for any signs of heating, and being ready to change over sharply if necessary. Here this practice is fairly safe, as changing-over operations, even with large sets, may be accomplished in a very short time, but in alternating work this is not always the case, and the precious moments spent in synchronizing have to be taken into account.

The attitude of the larger electricity supply concerns may be taken as indicating that the necessity of a preliminary full-power run is appreciated, for practically arranged for a test on artificial load after any repair of a serious nature, but the obsolete manner in which this is often carried out is surprising, and hardly creditable to those concerned. Quite recently one of the largest London high-tension electricity works afforded an exhibition to the passer-by of an alternator of some 500 kw. being run on a weird and wonderful arrangement of tubs placed in the station yard. High-tension cables strung about anyhow, no one to guard the apparatus, and no precautions for safety taken beyond a few half obliterated notices reading "Danger, 2,000 volts." This is not economical, it is not convenient, and it is certainly not safe. It is, perhaps, an extreme case, but very similar ones must be known to many.

Tubs as an artificial load even for the smallest sets are not convenient, and for large powers, in a short time of regular use, absorb enough money in the shape of wages for the men that dance attendance upon them to fit up a proper and permanent arrangement, and this in addition to the extreme inconvenience experienced in their use for dissipating considerable amounts of power. In all alternating and in every direct current works of any size, it will be found to pay to install a properly designed and permanent water load, and the apparatus being simple in the extreme, this may generally be done at very little expense.

Before starting out to design a suitable arrangement, there are one or two points that must be considered and appreciated. Primarily, the passage of either alternating or direct current through water produces heat, and this lowers its resistance very considerably as boiling point is approached. It therefore follows that for convenient working the water must be continually renewed in order to maintain its temperature and conductivity at some fixed and suitable point. Then the nature of the water must be taken into consideration, for although the specific resistance of supply companies' water

*From the "Electrical Engineer," London.

may be much the same all the world over, that of rivers and canals may be very different, the same stream even varying considerably according to the period of the year and the amount of impurities or refuse contained in it. This is especially the case with sluggish canal water; in the winter, when it is comparatively pure, its resistance is fairly high, but the advent of hot weather and putrescent matter lowers it greatly, sometimes to an almost incredible amount. The writer may cite a case in his own experience where the matter of one of the London canals varied so largely in conductivity at different periods of the year that while in winter a 2,000 volt alternator would be tested with the electrodes about 3 or 4 yards apart, in summer it was necessary to increase this distance fourfold to obtain an equal dissipation of power with similar electrodes.

The accompanying curve (Fig. 1) shows

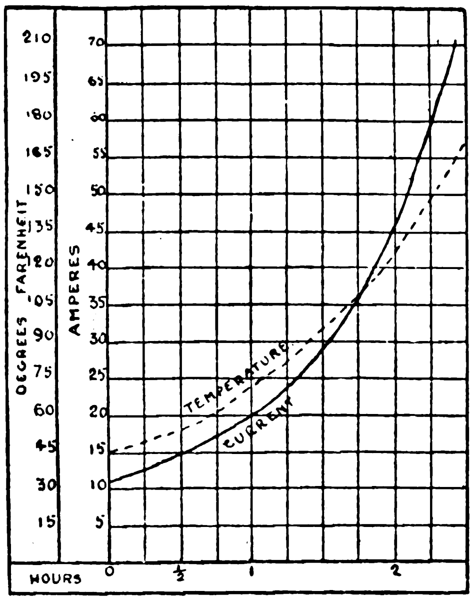


Fig. 1.

the results of a test made to determine the nature of the above-mentioned use of conductivity with heat. The water was taken from the mains of the New River Company, and the test, lasting 2½ hours, with no fresh water added to keep down the temperature, was with direct current at 500 volts. It will be seen that up to a certain temperature the rise in current and heat is proportionate; after this, however, the former gains rapidly on the latter. The results, as far as the actual figures go, are, of course, of no definite value, as these will vary considerably according to the volume of water in the tank, and, to a certain extent to the size of the electrodes employed. They, however demonstrate the fact that the rises do not take place in equal proportion for any length of time, and the ratio will very probably be similar for every class of water within reasonable limits.

The design of a permanent water resistance, as far as dimensions go, must, of course, be dependent upon the size of plant to be tested; but in any case it is better to err on the large side, as the greater the volume of liquid the more satisfactory will be the results. If a water rheostat is overloaded, the resultant violent boiling gives rise to vapor troubles, and an unsteady current owing to the level of the water immediately surrounding the electrodes being constantly varied by the ebullition. A very simple arrangement suitable for dealing with up to 1,000 kw. at 500 volts direct current is shown in Fig. 2. Both tanks

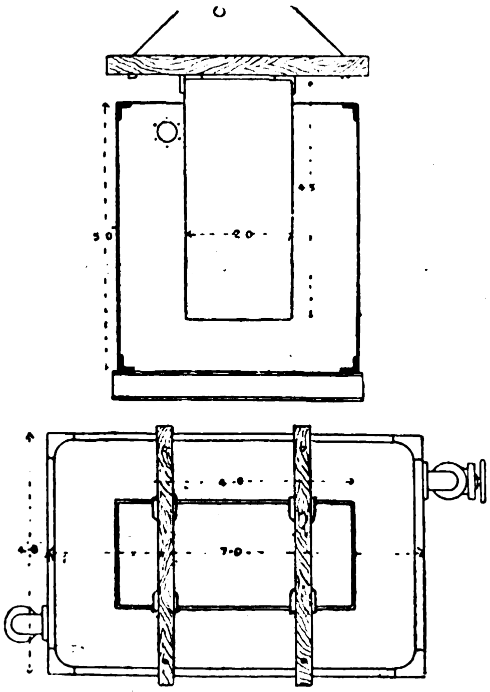


Fig. 2.

are of iron, and the inner one, which is suspended from some suitable bracket by wires, is bottomless. The immersion of this latter is regulated by aid of a small winch—preferably one of the ratchet type—and by this means the amount of current can be regulated to a nicety. It is fitted with two bars of wood, on to which the suspending wires are fixed, being broken in their length by a series of insulators. These beams have an additional function—viz., that of preventing a short-circuit should the wires break. In working with tubs or other rough apparatus, it is common practice to suspend the electrodes by the cables themselves, the idea being partly that if the wire breaks, thus causing the two opposite poles to come in contact, the current will be automatically cut off; but such a system practically debars the use of winches, unless of special and elaborate design. It is on the whole better practice to use a strong steel rope, making sure that it is always fit for its work.

To return to Fig. 2: the positive pole of the machine is connected to the inner tank by a flexible cable, and the negative to the outer, which is earthed, the apparatus thereby being made to all intents and purposes safe. An efficient supply of cooling water is arranged for by the two pipes at the ends of the outer tank; the outlet should be at the top to allow the hottest water to flow off and the inlet at the bottom, thus causing the cold water to intermingle with the entire contents of the tank. If the supply is drawn, say, through the station circulating water mains from some adjacent stream, the hot overflow is probably of no value and may be allowed to run to waste; but if, on the other hand, it is taken from the supply mains or other comparatively pure source, and not treated with chemicals in the tank, it may with advantage be passed into the hot-well, and an appreciable economy thus effected.

For testing high-voltage alternating current machinery of the same output the arrangement shown in Fig. 2 would be too large, but it may be adapted by substituting rod electrodes, the outer tank being earthed and simply used as a container and not as one of the poles. Single-phase work will necessitate two ¾ inch or 1 inch iron rods placed about 3 feet apart for 2,000 volts; and three-phase, of course, calls for three placed equidistantly at an angle of 120 degrees. Two-phase testing requires two separate tanks with two poles in each, the phases being treated separately as two independent single-phase circuits. One large tank such as the above may be used with only two inner electrodes and the tank as a common third, but in this case if accurate readings are required, say, for the purpose of an efficiency test, it must be divided between the two rods by a metallic plate electrically connected to the tank all round, as otherwise considerable current that obviously cannot be metered will pass between the two inners, falsifying the results to a large degree. When using rods as electrodes it will be found advantageous, in the interests of circulation of the water, to place earthenware drain pipes around them, with their upper ends slightly below the surface of the water. The violent boiling that takes place within the pipes owing to the restricted volume of water, causes a very rapid circulation upwards and over their tops, and this, of course, tends to the desired effect of keeping the whole of the contents of tank at approximately even temperature.

There can be no doubt that for the testing of machinery and for general station work the water load is the best and handiest medium. Other types, are, however,

found in use, some of which may be recommended for purposes apart from machine testing. The carbon rheostat as a power absorber is an old friend—indeed, one of the first, and although it is not much used at the present time it has done yeoman service in the past. The best form is the well-known one that is made up of a series of carbon plates placed in a frame fitted with a screw for tightening up or slacking back, the contact between the plates being thus increased or diminished, and the resistance of the whole varied in proportion. In this apparatus the resistance is due, not so much to that of the carbon itself, as to the more or less bad contact between the plates; and as these cannot be fitted or screwed up so as to touch equally over their surface, the current is often forced to take a diagonal path through the plates from one point of contact to another, and by this means the resistance of the whole is considerably increased over the theoretical amount that might be calculated for the particular length and diameter of the rheostat. Cooling is the chief difficulty presented by such apparatus, and for this reason it is only suitable for very small powers.

A very cheap and handy form of artificial load may be made up of galvanized iron netting wound into a spiral by the aid of non-inflammable insulating distance pieces, or folded backwards and forwards over an iron frame built up on insulators. The resistance of this netting is approximately .0036 of an ohm per yard of No. 18 gauge, 1 inch mesh, 1 yard wide, and the safe current capacity of such a piece would be about 100 amperes.

Different makes of netting would doubtless vary in these figures, and before building up such a rheostat careful resistance measurements of a sample would be necessary.

For testing small machines, such as exciters, a very handy artificial load may be made in this way. As a dissipator of heat, iron netting is naturally very effective, especially the kind composed of a right-angled mesh, in which case only one set of wires will carry current, while the others at right angles will serve to carry off much of the heat generated. Expanded metal also makes a very effective resistance, and in many ways is preferable to netting, being, for instance, stronger and requiring less support. It is, of course, dearer than the former, but to a certain extent makes up for this by requiring less in the way of holding up and clamping together. If intended for a permanency, its use is to be recommended over netting, but as a temporary expedient the latter is preferable owing to its extremely low cost.

WIRING LEAFLETS.

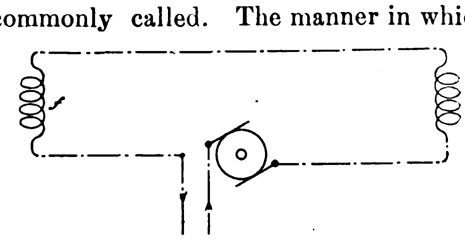
BY NEWTON HARRISON, E. E.

(*Continued from page 65.*)

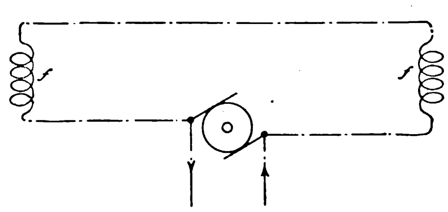
The subject of wiring is closely related to power transmission both as regards the wiring and the motors operated from distant sources of power. It is within the scope of wiring treated as a science as well as an art to consider the motor and briefly outline its principles of operation and construction. Motors are generally divided up as far as continuous current circuits are concerned into three great classes as follows:

The Series Wound.
The Shunt Wound.
The Differentially Wound.

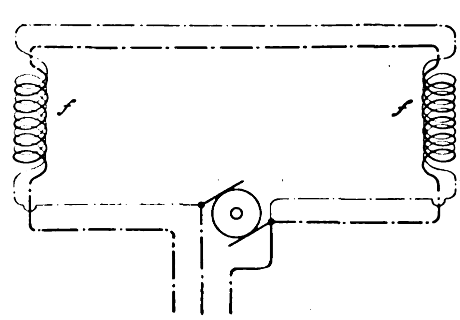
This classification relates to the winding of the magnets or fields, as they are commonly called. The manner in which



Connections of Series Wound Motor.



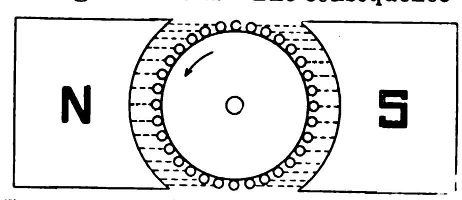
Connections of Shunt Wound Motor.



Connections of a Differentially Wound Motor.

the field is affected by the current flowing through its coils is indicated in the above tabulation.

The Principle of the Motor.—The motor and dynamo are reversible machines, the dynamo transforming mechanical energy into electricity, the motor transforming electrical energy into mechanical force. Any well made dynamo will operate successfully as a motor, in fact there is in many cases only a difference in name between the two machines. A dynamo is a machine in which the movement of conductors through the magnetic field means the development of electromotive force. As these conductors produce more current the source of mechanical energy is called upon to deliver more power until a balance is established. In a motor the same conditions exist in a reverse manner; the demand for more current takes place automatically until sufficient enters to do the work required by the outside load, whereas in the dynamo the extra lamps or motors turned on represent the demand for more current, and hence more mechanical energy. In the motor the extra current automatically and instantaneously augments as extra strain is put upon the motor. In the motor as well as the dynamo conductors rotate in a magnetic field. The consequence is



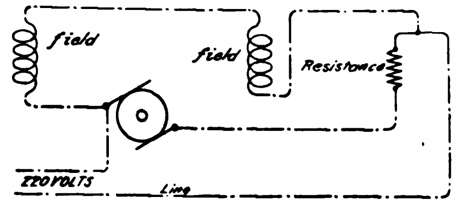
Conductors Cutting Lines of Force.

that electromotive force is developed which in the case of the dynamo is utilized for lighting, etc., but in the case of the motor this electromotive force is opposed to the electromotive force sending a current through the armature and is therefore called the "back EMF." The armature of a motor is simply an electro-magnet which experiences a series of attractive pulls, when current enters its winding through the action of the commutator and the position of the brushes.

The commutator and brushes constitute an automatic switch which sends the current into certain coils in certain positions on the armature. These coils magnetize the core of soft iron and a powerful tractive effort develops between the armature and the magnetic poles which embrace it. Summing the phenomena up, therefore, the action in a motor is simply the attraction between opposite magnetic poles which results in continuous rotation. As far as the mechanical results are concerned this is about all that need be said in a brief review of the situation, but the reactions occurring within a motor call for recognition in the scheme of wiring and reference must therefore be made to them.

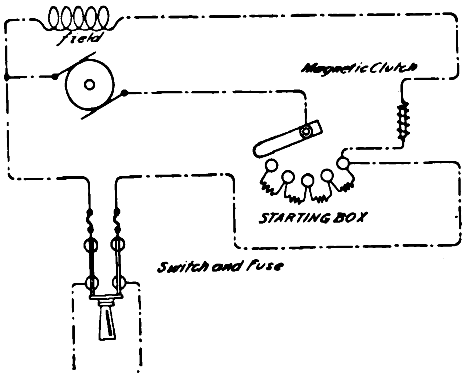
Effect of Back EMF. upon Wiring.—The armature of a motor can not instantaneously spin around at a high rate of speed, when current is turned on, therefore it cannot generate a back EMF. in time to stem the flood of current which will pour

through it. A heavy flow will take place because the resistance of the armature is too low to prevent it. It is necessary to interpose between the armature and the



PRINCIPLE OF THE CONNECTIONS OF A SHUNT MOTOR.

line a resistance sufficiently great to check any unusual flow of current. In the shunt and differentially wound motors this is imperative; in the series wound motor it is only necessary under certain circumstances. The current is restrained until the armature has gained sufficient speed to generate the required back EMF. to establish a balance between the power entering the motor and the effort called for by the load. The resistance is then cut out and the motor regulates its own influx and efflux of current by the back EMF. and this in its place is regulated by the load. In the following sketch a shunt



PRACTICAL CONNECTIONS OF A SHUNT WOUND MOTOR.

motor is shown with the starting box interposed when the armature begins to rotate. The boxes are so constructed that the final movement of the handle cuts out all resistance and connects the motor to the mains.

Points About Motors.—In the wiring of a shunt motor the fields must be on *first* and the pole pieces must be tested to discover this fact. Next, the current must pass into the motor through the resistance box and the armature will start slowly. The final throw of the handle of the starting box must not cause any unusual development of speed. A series motor must never be started without a load on. If this rule is not observed the motor will rotate at an enormous rate of speed, each accession of speed developing a velocity which will only cease by the opening of the switch or the destruction of the motor.

A differentially or compound wound motor represents a combination of the two windings. The principle involved is this: that by weakening the field of a shunt motor the speed of the armature increases. In consequence, the current in the series coil of the motor tends to reduce the strength of field and increase its speed when the load tends to diminish it.

Efficiency of Motors.—The efficiency of the motor is twofold, the electrical efficiency and the commercial efficiency. The electrical efficiency is the ratio between the back EMF. and the impressed or external EMF. The commercial efficiency is the ratio between the power given out by the motor and the power it absorbs. Unless a motor has a high electrical efficiency it cannot have a high commercial efficiency. The back EMF. and therefore the electrical efficiency can be calculated in the following manner: Multiply the resistance of the armature by the current and subtract the product from the impressed EMF. to get the back EMF. For instance, suppose a motor has an armature resistance of .01 of an ohm and takes 50 amperes at 110 volts, what is the back EMF.? According to the above principle $50 \times .01 = .50$ and subtracting .5 from 110 gives 109.5 back EMF. The electrical efficiency equals $109.5 \div 110$ or 99.5 per cent. If the power developed in this case equals 5 hp. then the commercial efficiency equals $5 \times 746 \div 5{,}500 = 3{,}730 \div 5{,}500 = 67.5$ per cent.

In motor wiring calculations the commercial efficiency is of the greatest consequence if given in connection with the EMF. of the motor. The circular mils required for a motor line can be calculated if the horse power of the motor, its efficiency, the voltage, the length of the line and the drop are given. The formula for calculating the circular mils is as follows:

$$\text{C. M.} = \frac{\text{HP. of motor} \times 746 \times \text{length of wire} \times 11}{\text{volts of lines} \times \text{drop} \times \text{efficiency in \%.}}$$

Taking a practical case, what are the circular mils of a motor line with the following data:

HP. of motor = 10.
Length of run = 200 feet.
Volts of line = 220.
Drop of line = 10 volts.
Efficiency = 80 per cent.

C. M. $= 10 \times 746 \times 400 \times 11 \div 220 \times 10 \times .80 = 18{,}650$ or a No. 7 B. & S. To check the results find the resistance of 400 feet of No. 7 wire and multiply by the current, which in this case is approximately 50 amperes.

Resistance 400 feet No. 7 = .2 ohm.
$.2 \times 50 = 10$ volts drop as indicated above.

The efficiencies of motors vary very much, but the average efficiency of the general run of direct current motors can be summed up in the following figures:

Horse power.	Efficiency.
1	70 per cent.
2	75 " "
3	80 " "
4	82 " "
5	85 " "
6	87 " "
7	88 " "
8	89 " "
9	90 " "
10	91 " "

A comparative table showing the relationship between the efficiency of a motor and the size of wire required will be instructive in showing how a low efficiency and high efficiency motor affect the contractor's expense in wiring:

Efficiency of motor.	Circular mils.
50 per cent.	29,840
55 " "	27,127
60 " "	24,866
65 " "	22,938
70 " "	21,314
75 " "	19,893
80 " "	18,650
85 " "	17,553
90 " "	16,577

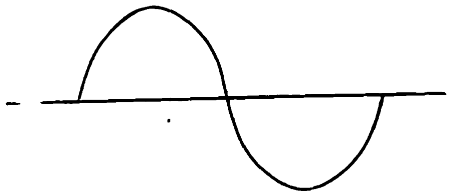
The above table is built from the problem just given with a 10 hp. motor and 80 per cent. efficiency, only the efficiencies are varied to show the change in the size of wire required. This problem is of the utmost importance, particularly in power transmission, where the weight of copper when heavy horse powers are transmitted becomes enormous unless limited by high pressures and efficiencies. The weight of copper can be likewise developed with respect to the efficiency as shown in the following table, in which one mile of wire is considered, a 10 hp. motor and 500 volts pressure:

Efficiency.	Weight in pounds per mile.
50	1,109
60	924
70	792
80	693
90	616

The tendency on all sides is to adopt high pressure systems which represent a combination of direct and alternating current machinery.

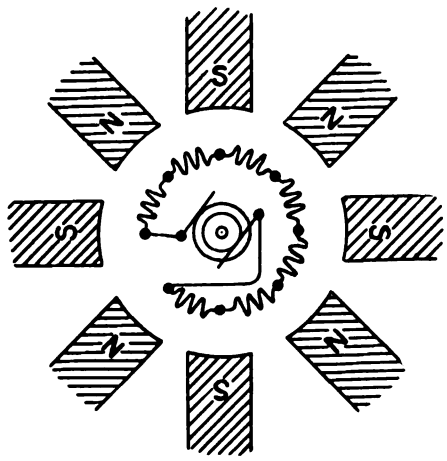
The Alternating Current.—In the lighting of incandescent lamps alternating as well as direct current is employed. The alternating current differs from the direct current in so far as it consists of a series of systematic impulses or waves which rush back and forth in the circuit a certain number of times a second. The dynamo generating an alternating current

becomes an alternator simply because it has no commutator, the armature winding ending in two rings instead of being connected to copper strips insulated from each other. The direct current dynamo



Rise and Fall of Electromotive Force in an Alternator.

also generates an alternating current, but this current is modified in the sense that its impulses are all sent along in the same direction by means of the commutator and brushes. The original name for the commutator was rectifier, because it rectified



Elements of an Alternator.

the impulses. There are various characteristics to alternating currents which must be known in the handling of them for commercial purposes.

The frequency or number of periods per second is the term used to define the number of complete reversals of current per second. Each complete reversal is due to the wire passing two poles—a north and a south pole. While passing before the north the current flows in one direction, and when passing the other in the opposite direction. The frequency or number of periods per second can therefore be calculated in the following manner:

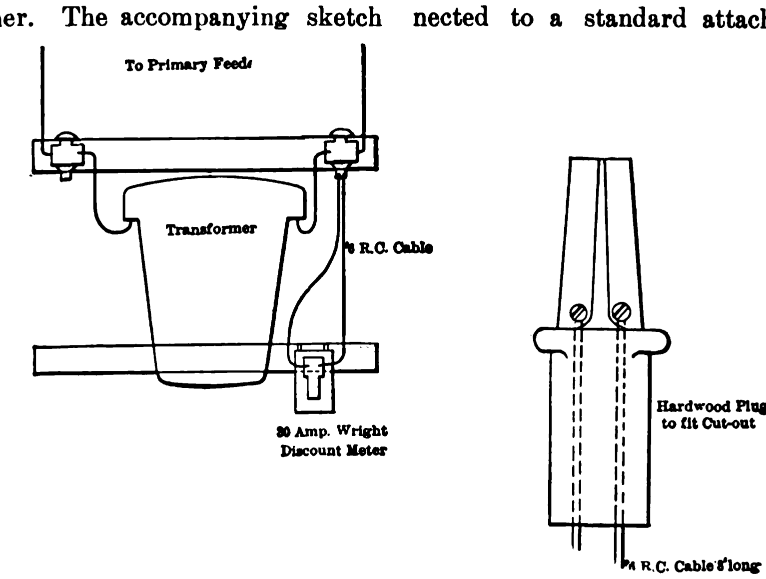
Frequency.—The frequency = revolutions per second × one-half the number of poles. For instance, what is the frequency of an alternator with 8 poles and a speed of 30 revolutions per second? Frequency = 30 × 4 = 120 reversals. The utilization of an alternating instead of a direct curent is due to many advantages in transmission possessed by an alternating current system over a direct. This first manifests itself in a great saving in copper and power, secondly in cost of construction of both dynamos and line. In connection with wiring the question which arises is this, "Is the line inductive or non-inductive?" In other words, are coils in any way associated with the circuit so as to develop reactive electromotive forces or not. It is therefore necessary in preparing the plans of an alternating current lighting and power system to be sure that the circuits are free from disturbing inductive influences.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

A SIMPLE METHOD OF DETERMINING THE DEMAND UPON INDIVIDUAL TRANSFORMERS.

It is ofttimes necessary to know the amount of current that a certain transformer is called upon, by the lamps or other apparatus connected, to deliver. The easiest way to obtain this is to measure the primary current passing to the transformer. The accompanying sketch and the short description following will give an idea of a simple arrangement that makes testing transformers very easy indeed. We are using the insulator type, primary cut-out, manufactured by the General Electric Company. A duplicate plug was made of hard wood, with an extended handle 6 inches long and 2 inches in diameter. Two of the brass clips from an old plug were placed upon the wooden one, and through two holes in the handle, two No. 6 rubber-covered cables were connected to said clips. These cables are about 8 feet long and connected to a 30 ampere Wright discount ammeter, which is mounted upon a board about 8 by 12 inches. Upon the back of the board are two pieces of wrought iron of suitable size to hook over an ordinary cross-arm.



Arrangement of Transformers.

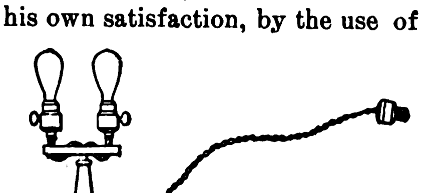
To test a transformer, it is only necessary to place the ammeter upon a convenient cross-arm, pull out the plug in one of the transformer cut-outs and insert the plug upon the end of the cable. We usually leave it in service for two nights, and then remove it to some other transformer.

Geo. S. Haley, Rutland, Vt.

METHOD OF SHOWING DIFFERENCE BETWEEN NEW AND OLD INCANDESCENT LAMPS.

With companies whose customers purchase their own incandescent lamp renewals it is frequently necessary to adopt some method to induce the customers to renew dim lamps before they burn out. The following has been used with good satisfaction:

Two standard lamp sockets are attached rigidly to a small strip of brass and wired in multiple to a lamp cord that is connected to a standard attachment plug. Upon receiving complaint of poor lights, an inspector takes this two-light device and a voltmeter to the house or store making the complaint, and after ascertaining to his own satisfaction, by the use of the



voltmeter, that the potential is all right on the secondary wires, shows the complainant the difference in illuminating power between an old and a new lamp. To one socket of the two-light device he attaches a new lamp, and to the other socket one of the lamps complained of; then, after turning out all lights in the room, the two-light device is held over a

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

newspaper and the old light turned on, then cut-off and the new light turned on; this repeated two or three times shows the difference between the two lamps.

The illustration is more effective to the layman than a voltmeter test, and, ordinarily, it is not difficult to convince a customer that the discolored lamps need to be replaced by new ones.

E. H. MATHER, PORTLAND, Me.

A CONSTRUCTION OF CROSS-ARMING WHEREBY SERVICE CONNECTIONS CAN BE TAPPED FROM ANY FEEDER, AND RUN IN ANY DIRECTION FROM VERTICAL TO PERPENDICULAR AND IRRESPECTIVE OF SIDEWISE DIRECTION.

By observing the method of construction, it can be seen that the connections are made and run with absolute safety from contact with other wires, and moreover, without the use of knobs or any like substitute.

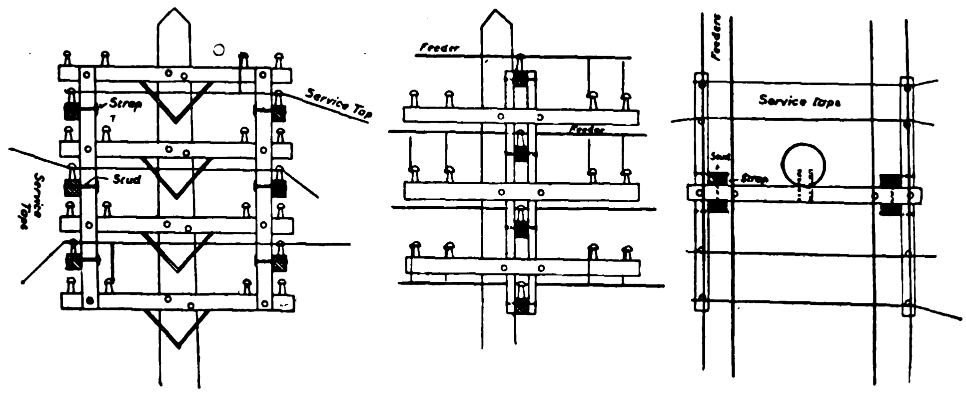


DIAGRAM SHOWING METHOD OF CONSTRUCTION

There are four feeder arms which are used as follows:

Top arm—arcs—both city and commercial.

2d arm—two 500 volt private power circuits.

3d arm—2,000 volt primaries, alternating current lighting.

4th arm—three-wire secondaries.

To these four feeder arms, four pieces of "two by fours" (two on each side) are bolted. These act incidentally as braces for the feeder arms, and as supports for the service tap cross-arms. These cross-arms are clamped, by means of studs and strap to the "two by fours" midway between the feeder arms. The top connections run perpendicular to the direction of the feeders, and half-way between them, thus insuring safety from contact and a jumble of wires, the evil of which is too well known to mention. This construction is especially adaptable to line work on junction poles, where it may be used to excellent advantage. By using only four of the six pins, a lineman has a space free from live wires in which to climb and work. This construction, however, is limited to southern latitudes, as in the north the network of cross-arms would offer too much surface for the accumulation of sleet and ice.

GEO. CUSHMAN, San Antonio, Tex.

SOME RESULTS OBTAINED DURING THE USE OF VARIOUS ELECTRIC WIRING SYSTEMS.

Among the large amount of information which has lately been forthcoming in the press with regard to the above problem, there appears to be a singular lack of report as to actual experience resulting from an extended use of the various systems, writes a contributor to the London *Electrical Engineer*. Electric wiring is far from being in its infancy, and a sufficiency of time has certainly elapsed to enable the seeker after definite information to find some sure ground to walk upon. The writer has been conversant with the principal forms of wiring in use for the past 15 years, and ventures to think that the merits and demerits of each are not difficult to define in the light of actual results obtained in practice.

Undoubtedly the basis of all decisions as to which type to adopt must be a careful consideration of the conditions under which they are expected to give satisfaction. It is scarcely possible to lay too much stress upon the above point, seeing that one system will give excellent results when used in surroudings where another would prove a lamentable failure. The writer was recently asked by a friend, who is an architect and surveyor by profession, what class of protection he recommended for electric light wiring, as he (the architect) had just had a lot of trouble with an installation in which the wires were run in metal tubes. As anticipated, the tubes proved to be of the cheap close-joint variety, and after a short length of time so much moisture had collected in the system that the insulation had completely broken down and rendered rewiring necessary.

There is ample confirmation on every hand that the above class of tubing is quite unsuitable unless the position is an extremely dry one, and certainly should never be buried in plaster. Careful inspection of a breakdown such as mentioned above, constantly reveals the fact that both the surface of the insulating covering on the wire and the interior surface of the tube are covered by beads and films of moisture, partly caused by condensation and partly by water entering the crevice of the tube by capillary attraction. The actual wire carrying the current is therefore only separated from the earthed metallic tubing by the thickness of the insulating covering, and this soon becomes saturated by the moisture, causing such a strain upon the insulation that breakdown is inevitable.

Now let us suppose that in the place of the ordinary close-joint tubing a type has been used provided with an insulating and non-absorbent lining. By the adoption of this class of tube we obtain the advantages of a large decrease in the amount of moisture forming by condensation, and a complete absence of water introducing itself through the longitudinal joints. There is also an immense increase in the insulation resistance between the conductor and the earthed tubing. As the result of actual experience the writer has no hesitation in saying that a light form of close joint tube, provided with an insulating and non-absorbent lining, will give excellent results wherever great mechanical strength is not required.

Where great mechanical strength is necessary a solid drawn or brazed tube must be employed, but this must also be fitted with an insulating and non-absorbent lining, or trouble is certain to ensue. An ideal form of lined tubing would consist of a tube of whitewood, thoroughly saturated with paraffin wax, and protected by an outer tube of thin enameled steel. The above should not be expensive to manufacture, and would give excellent results in all respects, and would have the great advantage that the wiring could be easily and safely drawn in.

The question of satisfactorily earthing a system of metal tubing when the joints are not screwed has recently received considerable attention. A very satisfactory plan is as follows: The interior of the socket and the entering end of the tube must be roughly cleaned by passing a rasp over them, and when in position a thin strip of hard copper is driven in between the tube and socket. The copper strips should be about 1 inch long and ½

inch wide, and cut from different gauges of sheet metal in order to meet all cases.

So far no mention has been made of our old friend wood casing, but the writer nevertheless holds it in the highest esteem. Where it affords a sufficient mechanical protection, and is not objected to on account of appearance, it should be used, and will prolong the life of the cables to a greater extent than any metallic tubing in existence. The writer recently saw some wiring removed from wood casing, where it had lain for 17 years, and the condition was excellent. This has been proved by practice countless times, and there cannot be the slightest doubt that wood casing is a most excellent and satisfactory device, and may be used with absolute confidence where not subject to rough usage.

Electrical Visitors From Abroad.

According to a bulletin issued by the American Institute of Electrical Engineers, there will be 74 visitors from the Institutions of Electrical Engineers of Great Britain, to participate in the International Electrical Congress. Italy will be represented by 43 members of the Associazione Elettrotecnica Italiana. Germany and France will also be represented. The visitors will arrive at the end of the present month.

Northwestern Electrical Association.

Secretary Mercein writes us that the St. Louis meeting will be held September 12-16, the week of the great International Electrical Congress there. Headquarters will be at the Forest Park University Hotel, a first-class, permanent and fireproof building in its own spacious grounds, and within a stone's throw of a main entrance to the Exposition. Five lines of street cars to and from the city pass the hotel. Confidential rate $1.50 for each person, two in a room.

An Appreciative Reader.

Editor ELECTRICITY.

SIR: Through the courtesy of a friend I am enjoying the privilege of reading your most valuable paper and I find in it articles of inestimable value to the electrician, dynamo tender and those who are in charge of boilers and steam engines.

I am particularly interested in the articles on "Safe Pressures for Steam Boilers," by Mr. W. H. Wakeman. In my opinion they are just what is needed to awaken the interest of not only those who own and control steam plants, but will also create a greater interest on the part of those who are directly in charge of the care and responsibility of the same. Let the good work go on. Yours very truly,

W. M. GULLIFORD.

Greenville, Mercer County, Pa.

The Government officers have decided to use electrical machinery as far as possible in the construction of the Panama Canal.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 2, 1904.

Electric Railways and Appliances.

766,177. Trolley. Orin Funkhouser, New Brighton, Pa. Filed June 26, 1903.

766,330. Flexible Metal Band for Traction-Wheels. Egbert O. Doak, Sac City, Ia. Filed May 6, 1904.

766,335. Electric Railway. Philip Farnsworth, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 21, 1901.

766,381. Electric Railway and Controlling Device Therefor. William B. Potter, Schenectady, N.Y., assignor to the General Electric Company. Filed March 3, 1898.

766,399. Current Collecting Device for Electric-Railway Systems. Abraham A. Shobe and William Embley, Jerseyville, Ill. Filed Sept. 26, 1903.

766,428. Car-Fender. Franz Csanitz, Vienna, Austria-Hungary. Filed March 26, 1904.

766,625. Third-Rail System. Thomas Jenkins, New York City. Filed April 6, 1904.

766,650. Electric Trolley. George Ondo, Delancey, Pa. Filed March 10, 1904.

766,766. Trolley-Wheel. John T. McCafferty, Mifflin Township, Allegheny County, Pa. Filed Aug. 23, 1902.

Electric Lights and Appliances

766,187. Means for Extinguishing Arcs. Rudolf E. Hellmund, New York City. Filed Nov. 28, 1903.

766,284. Insulated Hanger for Arc-Lamps. Henry J. Pfiester, Cincinnati, O., assignor of one-half to William A. McCallum, same place. Filed March 7, 1903.

766,321. Tabulating Machine for Incandescent Lamps. William R. Burrows, Newark, N. J., assignor to the General Electric Company. Filed March 19, 1902.

766,418. Incandescent Burner. James A. Bowen, Providence, R. I. Filed March 7, 1904.

766,496. Electric-Arc Lamp. Arthur S. Deem, Reading, Pa. Filed Jan. 26, 1904.

766,559. Mounting for Searchlights. William O. Webber, Boston, Mass., and John McGeorge, Cleveland, O., assignors to the Wellman-Seaver-Morgan Corporation, Cleveland, O. Filed Jan. 25, 1904.

766,727. Hydrocarbon Incandescent Lamp. Winfield S. Proskey, Ocala, Fla., assignor, by mesne assignments, to the Proskey Light Company, Jersey City, N. J. Filed Jan. 9, 1900. Renewed Jan. 30, 1902.

766,787-788. Inclosed-Arc Lamp. Ozro N. Wiswell, Lynn, Mass., assignor to the General Electric Company. Original application filed May 4, 1899. Divided and this application filed July 24, 1902. Renewed June 17, 1904.

Electrical Machinery and Apparatus.

766,166. Electric Sparking Plug for Gas-Engines. Albert Buchner and Elmer P. McClure, Chicago, Ill. Filed March 19, 1902.

766,201. Magnetic Chuck. Charles W. Sponsel, Hartford, Conn., assignor of one-half to Charles F. Taylor, same place. Filed Feb. 6, 1904.

766,248. Mechanical Electric-Current Interrupter or Circuit-Breaker. John O. Heinze, Jr., Lowell, Mass. Filed March 9, 1904.

766,256. Electric Time-Switch. Arthur W. Hutchins, Providence, R. I. Filed April 27, 1904.

766,288. Electric-Welding Clamping Device. Adolph F. Rietzel, Lynn, Mass., assignor to the Thomson Electric Welding Company, same place. Filed Dec. 4, 1903.

766,293. Turbine. Johann Stumpf, Charlottenburg, Germany, assignor to the General Electric Company. Filed Nov. 7, 1903.

766,309-310. Control of Alternating-Current Motors. Gabriel Winter, Vienna, Austria-Hungary, and Friedrich Eichberg and Johann Alexander, Berlin, Germany, assignors to the General Electric Company. Filed Nov. 16, 1903.

766,311. Circuit-Breaker. Gilbert Wright and Harold C. White, Pittsfield, Mass., assignors to the Stanley Electric Manufacturing Company. Filed Oct. 7, 1903.

766,314. Power-Transmitter. Frederick W. Yost, Chicago, Ill., and William C. Conant, Atlanta, Ga. Filed Aug. 17, 1901.

766,319. Switch Attachment for Cluster Electric Fixtures. Walter L. Bradshaw, Cambridge, Mass. Filed May 27, 1904.

766,323. Multiple-Cylinder Engine. John G. Callan, Lynn, Mass., assignor to the General Electric Company. Filed Sept. 4, 1903.

766,325. Regulating Electric Motors. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company. Filed April 15, 1898.

766,327. Controller. Fred B. Corey, Schenectady, N.Y., assignor to the General Electric Company. Filed Feb. 4, 1903.

766,391. Remote-Switch-Control System. John L. Hall and Howard R. Sargent, Schenectady, N. Y., assignors to the General Electric Company. Filed Nov. 26, 1902.

766,468. Rectifying and Interrupting Alternating Currents. William Scheidel, Chicago, Ill. Filed Dec. 31, 1903.

766,507. Time-Circuit Controlling Apparatus. Henry C. Little, Boston, Mass. Filed Aug. 26, 1903.

766,551-552. Clutch Device and Clutch-Device Power Transmitting Mechanism. Thomas L. Sturtevant, Quincy, Mass., and Thomas J. Sturtevant, Wellesley, Mass. Original application filed Jan. 5, 1904. Divided and last application filed Feb. 16, 1904.

Telephones and Telephone Apparatus.

766,192. Measured-Service System for Party-Lines. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed Dec. 14, 1901.

766,223. Telephone System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed March 9, 1903.

766,224. Selective Signaling System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Campany. Filed April 6, 1903.

766,225. Apparatus for Transmitting Messages by Telephone. Edgar W. Day, Baltimore, Md. Filed April 11, 1904.

766,241. Telephone Locking Mechanism. Rudolph W. Goeb, St. Louis, Mo., assignor to the Controller Company of America, same place. Filed April 20, 1903.

766,354. Telephone-Box. Charles C. Hughes, Baltimore, Md. Filed Dec. 10, 1902.

766,355. Telephonogram Apparatus. Christian Hulsmeyer, Dusseldorf, Germany. Filed Oct. 13, 1902.

766,375. Service-Meter for Telephone Exchanges. James L. McQuarrie, South Orange, N. J., assignor to the Western Electric Company, same place. Filed Dec. 11, 1903.

766,450-451-502-503. Telephone Exchange System, Telephonic Transmission, Telephony. Isidor Kitsee, Philadelphia, Pa. Filed Nov. 23, 1900; Jan. 22, 1901; March 13, 1901, and Aug. 2, 1902.

Miscellaneous.

766,189. Telegraphy. Francis W. Jones, New York City, assignor to the Postal Telegraph Cable Company. Filed Nov. 13, 1903.

766,213. Pneumatic-Tube System. George F. Atwood, Hoboken, N. J., assignor to the Western Electric Company. Filed Nov. 28, 1902.

766,216. Storage Battery. Frank T. Cable, New Suffolk, and Grant E. Edgar, Greenport, N. Y., assignors to the Electric Boat Company. Filed Feb. 26, 1903. Renewed Dec. 19, 1903.

766,353. Electric Billiard-Register. Porter S. Hotchkiss, Lake City, Ia., assignor to the Electric Billiard Register Company, same place. Filed Aug. 6, 1903.

766,360. Fire-Alarm System. Benjamin P. Ketcham, Carthage, N. Y. Filed Aug. 6, 1903.

766,365. Apparatus for Washing Storage Batteries. James P. Lough, New York City. Filed May 17, 1904.

766,430. Telegraphic Instrument. Arthur R. Dickey, Missouri Valley, Ia., assignor of one-half to Theodore F. Van Dorn, Omaha, Neb. Filed May 13, 1902.

766,474. Receiving-Telegraph Instrument. Charles R. Underhill, Providence, R. I. Filed June 1, 1903.

766,504. Method of Producing Elements for Electric Cells. Isidor Kitsee, Philadelphia, Pa. Filed April 14, 1902. Renewed June 16, 1904.

766,767. Electric-Connection-Rosette. Mortimer Norden, New York City assignor, by mesne assignments, to Mary Bittner, same place. Filed Sept. 19, 1903.

THE TELEPHONE WORLD.

New Independent Company for Ohio.

Some few months ago S. C. Thayer, of Bradford, N. Y., formerly of Newton Falls, O., and who was instrumental in securing 'phone service for that village, as well as one of the promoters of the Salem Telephone Company, now absorbed by the Columbiana County Telephone Company, visited Girard, and after looking the ground over, thought the time ripe for the installation of an Independent telephone system in that village,

As a result the Girard Telephone Company has been incorporated at Columbus with a capital stock of $35,000. The incorporators are E. L. Hauser, G. J. Jones, W. J. Wallace, J. C. Krehl, S. C. Thayer, E. H. Lotze and R. T. Izant.

The company will at once begin work toward the installing of an Independent system as soon as the village council grants it a franchise. An exchange with a capacity of 400 telephones will be installed under the direction of Mr. Thayer, who will be the superintendent of the plant. The company will have a working understanding with the Youngstown Telephone Company and the Warren & Niles Telephone Company, thus furnishing service to Youngstown, Niles, Warren and points in the two counties,

At present, and for years, Girard has only had the Bell service, and the people have been forced to take the service given and pay 10 cents to telephone to Youngstown, and other places in proportion. The new company will furnish 5 cent service between Girard and Youngstown. The Warren & Niles Company will extend its line a mile and a half from a point between Niles and Mineral Ridge to connect up with the proposed new system.

The promoters back of the company are well-known business men, and will carry out what they have agreed to furnish. As yet the company has not decided upon a location for its exchange, but several options have been secured. The company expects to start out with 300 subscribers and the plant is to be ready for operation by January 1. A greater portion of the lines will be underground and of the very best construction.

The Empire State and Automatic Telephone Companies, of Auburn, N. Y., have made an agreement whereby both corporations would use the same poles in all parts of that city. A formal contract has not yet been entered into, but the terms have been agreed upon. This arrangement will obviate the use of about half the poles now in the streets.

When the Pennsylvania Railroad Company's new elevated freight line through West Philadelphia is put into complete operation the movement of trains upon it will be governed by the block system. A decided innovation will be the use of telephones between the towers instead of telegraphy.

The Amberg Telephone & Telegraph Company, capitalized at $3,000, is a new concern in Wisconsin.

Manager Meyers, of the Washington, Ill., Telephone Company, has completed building a line to Cooper.

Pennsylvania Companies to Ask for a Charter.

Application will be made August 23 by Messrs. W. B. Trask, W. H. Wilson, James Russell, W. D. Barnard and Ellis L. Orvis, to the Governor for a charter of incorporation for a company to be known as the Union Telephone Company, having its principal office in the city of Erie, the purpose of which company is the building, constructing, maintaining and operating telephone and telegraph exchanges, lines and systems, and the acquisition of telephone and telegraph exchanges, lines and systems by lease, purchase or otherwise, in the county of Erie, and to engage in the business of transmitting telephone and telegraph messages, communications, light and power by electricity, and charging for the same, and renting pole and wire lines and telephones.

Another concern, known as the Pittsburg-Butler Telephone Company, by which the Pittsburg & Allegheny expects to extend its service on the north, will ask for a charter from the Governor August 22. The applicants are J. G. Splane, president of the company; John S. Weller, its general counsel, and T. J. Shufflin.

Telephone Tangle.

The Northwestern Telephone Exchange Company of Minneapolis, Minn., has begun suit to enjoin the Tri-State Company from interfering with its Winona, Minnetonka and Willmar line, and Judge Elliott, of Minneapolis, has issued a temporary restraining order and set the case for August 15.

A new telephone company, known as the Consolidated Telephone & Telegraph Company, has been granted a charter in Tennessee. The incorporators are J. K. Barlow and J. F. Barlow, of Savannah; T. S. Hughes, of Clifton; F. E. Schwab, of Nashville; H. B. Stubblefield, of Densons, and W. N. Sloan, of Linden. The capital stock is $50,000. The company will operate lines in Perry, Wayne, Hardin and adjoining counties.

The announcement is made of the change of managers for the Youngstown, O., Telephone Company. W. F. Crossley, who has been manager for the past six months, retires, and George G. King, the general superintendent of the company, succeeds him. Mr. Crossley has accepted the position of State manager for the Colorado Telephone Company, with headquarters in Denver.

The farmers' telephone line in Flathead County, Mont., is getting along at a rapid rate, and the company has 150 miles of wire now up, and expects to put up 150 miles more, making a total of 300 miles of wire, which will be used in the line, connecting 200 farmers with Kalispell, and the telephone exchange when it is fully completed. About 600 telephones are in use and the line is being hurried to completion.

The Tate County Telephone Company, domiciled at Senatobia, Miss., with a capital stock of $1,000, was lately incorporated by J. F. Brewer, Phil A. Rush and others.

The Mt. Pleasant Telephone Company, of Mt. Pleasant, O., has increased its capital stock from $5,000 to $10,000.

New Telephone Companies.

Among the new telephone companies may be found the Cambria Co-operative Telephone Company of Cambria, Wis., with a capital stock of $1,000, and H. W. Thomas, Chris Hecker, E. D. Ford and 16 others as incorporators:

Another one from the same State is listed as the Union Grove & Paris Telephone Company of Racine County, capitalized at $2,000, and incorporated by Henry Barnes, O. P. Gorham and C.E. Barthoff.

In Washington County, Pa., the Farmers' Mutual Telephone Company, capitalized at $30,000, has lately been formed by S. N. Hopper, J. R. McPherson, E. K. McConnel, C. M. Linn, H. H. Bebout, R. G. Lutton, R. L. Munce, John Fulton B. B. Blaney, S. Otto Black, J. C. Peas, W. H. Martin and H. H. Mollnauer.

The Cuero & Cheapside Telephone Company, with principal office at Cheapside, Tex., has been incorporated by J. E. Lord, J. F. Elder and C. F. Carson.

The local telephone company at St. Johns, Mich., which handles an extensive rural service, is seeking to make its service indispensable by furnishing subscribers with the Government daily weather reports, and other important news of the day. Signals are rung each morning on all farm lines, and all who desire may get this report.

Articles of incorporation have lately been filed with the Minnesota Secretary of State by the Morton Rural Telephone Company of Morton, with a capital of $25,000. The incorporators are F. W. Orth, F. W. Penhall, M. J. Egan, Fred Watschke, George Welsh, R. B. Henton and Henry Beckman.

The Hutchinson Telephone Exchange Company, of St. Paul, Minn., has filed an amendment to its articles of incorporation with the Secretary of State doubling the capital stock to $50,000.

After a strike of one day the girls employed as operators for the Standard Telephone Company, at Doylestown and Newtown, Pa., returned to work. The strike practically tied up the company's service in the county.

A rural telephone system has been inaugurated to Rock Valley, west of Petaluma, Cal., covering an area of 10 miles square and supplying 100 subscribers.

The planters in the vicinity of Green Grove, Ala., have organized a company with $2,000 capital to furnish themselves telephone connection with Huntsville.

The Mutual Telephone Company has issued an amendment authorizing certain changes in route in Leake, Scott and Attala Counties of Mississippi.

The Southern Bell Telephone Company has purchased the local 'phone system of Cochran, Ga., from L. F. Blassingame.

Telephone Incorporations.

The Cherry Valley Telephone Company, Cherry Valley, O. Capital stock, $3,000.

The Majenica Telephone Company, Majenica, Ind. Capital stock, $2,000. Directors: A. M. Benson, Sherman Sprowl, George W. Gill, J. F. Hoover, Daniel Shideler and C. W. Meyer.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Allegheny, Pa.—The council has authorized the issuance of $40,000 electric light plant bonds.

Arlington, Tex.—The Arlington Light & Power Company has been incorporated, with a capital of $10,000, by W. Dugan, W. C. Weeks and others, to operate electric light plants.

Booneville, Ark.—The town council has passed on the proposed electric light plant.

Decatur, Ala.—J. L. Echols and associates, are contemplating erecting a $15,000 electric light plant for this city. Heretofore, Decatur has been getting her lights from the plant in New Decatur.

Edinburg, Ill.—An electric light company has been formed here, with a capital stock of $30,000, by L. E. Swigert, R. Harrington and R Wilkinson.

Greene, Ia.—A company of enterpirisng citizens has been organized to purchase and operate the electric light plant.

Griffin, Ga.—This town has voted $100,000 5 per cent. bonds for the construction of water and sewer systems, and the improvements of the city's electric lighting system.

Hibbing, Minn.—The electric light plant here is to be improved.

Jasper, Ind.—John M. Schmidt and Charles Renner have been awarded the contract for the erection of a power house for the municipal electric light and waterworks of this city at a bid of $2,182.59.

Kaukauna, Wis.—The common council will soon take up the electric light question, and it is expected that a final settlement will be made at that time.

Lockport, N. Y.—The American District Steam Company has asked the common council to grant a franchise to operate a system for supplying electricity for light, heat, power, etc.

Norfolk, Va.—The merchants of this city are determined to better conditions regarding the price of lighting, which, it is claimed, is higher here than in many cities the size of Norfolk. They are said to be backing a new company, which will, in the near future, ask the councils for a franchise for a new electric light company which will be known as the People's Heat, Light & Power Company. It will have a capital of $100,000.

Pauls Valley, I. T.—Thompson Brothers, of this place, will construct a new electric light plant to replace the one recently destroyed by fire.

Plainwell, Mich.—The Brownell Electric Company has been granted the village lighting contract.

Pontiac, Mich.—The common council of this city has decided to advertise for new bids for lighting the city with electricity.

Royalton, Minn.—The people plan to have their electric light plant in operation in the early fall.

Seeleyville, Ind.—N. B. Stanley has presented a petition to the board of county commissioners asking for a franchise for the purpose of erecting poles through this city for electrically lighting it.

St. Joseph, Mo.—W. C. Stewart states that between $6,000 and $7,000 a year can be saved to the city in the operating expenses of the electric street lighting plant, if the present antiquated machinery is discarded and modern equipment installed in its place. The matter is to be voted on soon.

Westmount, Quebec.—This place is desirous of the establishment of an electric lighting plant, and Councillor Plow, chairman of the light committee, has given notice of a motion that at the September meeting of the council, he would move that a by-law be submitted, providing that the town erect at as early a date as possible, a plant to generate electricity to be used in lighting the streets.

Xenia, O.—The Xenia Heat, Light & Power Company, to whom a franchise in this city was granted by the council several months ago, intends to go ahead with its plans for a central heating plant here, and more especially an electric light plant in connection with the same to compete with the present electric light company, whose services have never been satisfactory.

STREET RAILWAYS.

Abilene, Kan.—Efforts are being made to induce the constructors of the Topeka-Council Grove electric line to build the line to Herington and this city. The business at this end would be remunerative because of the large amount of traffic between towns.

Barnesville, O.—The Barnesville & Woodsfield Electric Railway Company has commenced to secure options on right of way for the proposed line between here and Bethesda.

Beloit, Wis.—Prospects are bright now for the construction of the missing link in electric lines from this city to Chicago. John M. Roach, the magnate, recently went over the proposed route.

Blackwell, Okla.—W.T. Hutchings has incorporated a company composed principally of Pennsylvania capitalists to construct an electric line from Adair, I. T., to this place, costing $2,000,000.

Buffalo, N. Y.—The Buffalo, Gardenville & Ebenezer Electric Railway Company proposes to extend its line to Olean.

Chatfield, Minn.—A. L. Ober, of this place, is interested in a new electric railway between Decorah, Ia., and St. Paul.

Danville, Pa.—The Danville & Sunbury Electric Railroad Company has started surveying its new line.

East Orange, N. J.—It now seems a certainty that Irvington and this place will be connected by a crosstown trolley line.

Greenville, Ia.—A new company has been organized to construct an electric railway line from here to Leland, known as the Greenville & Leland Electric Railroad Company.

Harrisburg, Pa.—The Central Pennsylvania Traction Company will build a new power house.

Iowa City, Ia.—S. W. McKee, formerly of this city, now a Chicago promoter, has been here pushing an electric interurban scheme.

Omaha, Neb.—A new electric line is projected from here to East Des Moines. Attorney S. B. Wadsworth is interested.

Pennsboro, W. Va.—A trolley line from here to Harrisville is in sight. It will be built by a company consisting of C. Collins, M. A. Jolliff and others, as the incorporators.

Petersburg, Va,—A survey is being made for an electric railway line from this city to Albemarle Sound. The proposed railway line is to be built by capitalists of this State.

Santaquin, Utah.—D. R. Roberts, of Logan, is interested in the proposed electric railway from here to Preston, Ida.

Sioux City, Ia.—According to persistent rumors at the Iowa division headquarters of the Rock Island system, the company is making careful investigations looking to the equipment of sections of its lines for trolley service. It is stated that the plan is to use the same track for through trains, freights and local electric trains. The company's motive is a desire to spoil the plans of electric road companies that are planning a series of interurban lines to extend across the State from Davenport to Council Bluffs, closely paralleling the Rock Island tracks, taking in the best towns and greatly reducing passenger and freight business.

South Haven, Mich.—There is a report that the Graham & Morton Company are interested in a project to build an electric line from Kalamazoo to Benton Harbor.

Steelton, Pa.—The Steelton, New Cumberland & Mechanicsburg Electric Railway Company proposes to build a line to this place.

Wapakoneta, O.—Two preliminary surveys have been made of a new electric line in this part of the State to run from this city to Defiance, or from St. Marys to Defiance through territory not yet traversed by railroads, steam or electric.

West Alexandria, O.—The building of a traction line between Van Wert and Hamilton, through Alexandria, is now being forecasted locally, with a reasonable degree of accuracy, a corps of engineers having begun work recently in this vicinity, in the interest of the projectors of the line.

POWER PLANTS.

New York City.—Plans were filed last week for the $3,000,000 power house to electrify the Yonkers branch of the New York Central, which was reported sold to the Interborough Company. There will be two structures just above Glenwood station and work will be begun on August 15.

Sandy, Utah.—The Light & Power Company has decided to make arrangements to erect a station house in Bingham Junction and transmit power from there to this place and Murray.

BIDS WANTED.

Des Moines, Ia.—Sealed proposals will be received by Captain L. Hardeman, at his office here until August 26, for electric light fixtures, wiring and installing meters in certain buildings in this city.

Winnipeg, Man.—Sealed tenders will be received by John D. Simpson, secretary-treasurer of the City of Moose Jaw, Assiniboia, until August 15, for the construction of a city hall and power house for waterworks and electric lighting system. Plans can be seen at the office of E. H. Bissett, 399 Main street, Winnipeg, or at the office of Mr. Simpson.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12½@12¾c.; casting, 12⅜@12½c.

Earnings of the Chicago Union Traction Company in July do not show any material gain over July, 1903.

The Citizens' Telephone Company of Columbus, O., has increased its capital from $750,000 to $1,250,000.

The employes of the Consolidated Railway Company of New Haven, Conn., have voted not to go on strike.

President Lloyd of the Electric Storage Battery Company says it is safe to say there will be no reduction in October dividend.

The stockholders of the Southern Illinois Electric Railway Company have voted to increase the capital of the company from $2,000,000 to $2,500,000.

The Groton & Stonington Street Railway Company of Connecticut, will issue $375,000 first mortgage 5 per cent. bonds for construction and equipment.

The Birmingham (Ala.) Railway, Light & Power Company has authorized an issue of $10,000,000 bonds, to be floated by the Commercial Trust & Savings Bank of New Orleans.

Stockholders of the Hartford (Conn.) Electric Light Company have the right to subscribe at par for $200,000 additional capital stock, issued for extensions and improvements.

An officer of the General Electric Company says that the business of the Philadelphia office up to the close of June was about equal to that of the equivalent period last year.

It is reported that the Lehigh Valley Railroad Company will soon make public its plans for buying a few trolley companies and changing part of its line into a third-rail system.

An addition of $2,600,000 is to be made to the capital stock of the Buffalo (N. Y.) General Electric Company. A meeting will be held on August 17 to discuss the proposed increase of capital from $2,400,000 to $5,000,000.

The Westinghouse Electric Company has issued a circular to stockholders, offering 50,000 shares of new stock on the same terms as the 90,000 shares issued last May, at $80 per $50 share, or 160 per cent. Of this issue 37,500 shares are stated to have been underwritten at the subscription price.

It is believed in well informed quarters in the Street that the rise in Metropolitan of New York represents a market movement against the large short interest in this stock. Some time or other the Metropolitan and the Interborough will doubtless be brought under a single control, but the time is not yet.

Judge Bischoff, of the New York Supreme Court, on Monday denied the application of the Greater New York Security Company for an order permitting it to come in as a party plaintiff in the suit brought by Henry Gardner against the Marconi Wireless Telegraph Company for an accounting and appointment as receiver.

A trust deed and first mortgage was filed in the County Register's office at Yonkers, N. Y., on Saturday by the Danbury & Harlem Traction Company of New York City. The mortgagee is the Knickerbocker Trust Company. The Traction Company gets gold-bearing first mortgage bonds of the value of $500,000 to pay debts, and in security for the mortgage the Traction Company gives all title and interest in railroad franchises and real estate in the towns of Danbury and Ridgefield, Conn.; North Salem and Lewisboro, N. Y. The railroad line is 13 miles long.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Aug. 8
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	150½
Metropolitan Street Railway	120
Metropolitan Securities	88⅞
Ninth Avenue	195
Third Avenue	122½
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	234
Brooklyn Rapid Transit	51⅝
Jersey City, Hoboken and Paterson	20
North Jersey Street Railway	..
United Company of New Jersey	..
Philadelphia.	
Consolidated Traction of New Jersey	67
Philadelphia Traction	98½
Union Traction, $17.50 paid	54⅛
Boston.	
Boston Elevated, full paid	148⅜
West End Street, com	91
do. do. do. pref	111¼
Chicago.	
City Railway	168
North Chicago	71
Union Traction, com	4⅛
do. do. pref	29
ELECTRIC LIGHT AND ELECTRIC MFG. COMPANIES' STOCKS.	
New York City.	
Electric Boat, com	42
do. do. pref	75
Electric Lead Reduction	¾
Electric Vehicle, com	9
do. do. pref	14
Westinghouse, com	158
do. pref	190
General Electric	163
Boston.	
Edison Electric Illuminating	251
General Electric	162¾
Massachusetts Electric Companies, com	17¼
do. do. do. pref	69⅞
Westinghouse Electric & Mfg., com	80
do. do. do. pref	90⅛
Chicago.	
Chicago Edison	144
National Carbon, com	29½
do. do. pref	104½
Philadelphia.	
Electric Company of America	9
Electric Storage Battery, com	61
do. do. do. pref	..
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	138½
Western Telephone Company	12¾
New England Telephone Company	124⅛
New York.	
American Telegraph & Cable Company	91
Commercial Cable Company	180
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	142
Postal Telegraph Cable Company	....
Western Union Telegraph Company	89
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..
INDUSTRIAL AND MISCELLANEOUS STOCKS.	
Otis Elevator Company	29
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

The New York Subway.

Twice the opening of the Rapid Transit subway in this city has been postponed, owing principally to labor troubles. It is now stated that the patient citizens will have an opportunity of riding in the underground cars by September. Let us hope that such will prove to be the case, although there is some doubt about it, as the electrical workers are now on a strike. It is true that about 80 per cent. of the electrical work is already finished and an endeavor is being made to complete the remaining 20 per cent. with non-union workers, but there are only comparatively few of the latter on hand, and if the road is to be fully ready on the date specified some amicable agreement between capital and labor will have to be reached.

So far as the operating company is concerned every thing is in readiness to run the cars as soon as the tunnel is finished. A school for motormen has been in existence for some time in the yards of the company at Ninety-ninth street and Third avenue. Here for months past hundreds of men have been trained to handle the controller and braking apparatus and have also been taught the signal system, the grades, curves and station stops in the subway. Consequently the delay is not due to the operating company, which moreover has 800 cars ready for service.

As regards the strike, it is sincerely to be regretted that capital and labor cannot work together in this instance—and in others for that matter—without drastic measures having to be adopted by one side or the other. In any line of endeavor employers should be considerate of their employes, and the latter should on the other hand not go on a strike except as a last resource and after arbitration and everything else had failed. When a strike is on both sides lose money and very frequently little or nothing is gained in the end.

It is to be hoped that the subway trouble, especially so far as the electrical workers is concerned, will soon be adjusted to the satisfaction of all hands.

* * *

Mountain Climbing by Electricity.

The past six years has seen electrical propulsion applied to mountain climbing. There have been a number of such railways built in this country but far more have been constructed abroad. Probably the most recent and by far the most important of these is that to the top of the Jungfrau in Switzerland. The road is nine and one-half miles in length and in that distance rises 6,883 feet. Grades of 25 per cent. are frequently met with, and with a view to overcoming them a new electric locomotive has been adopted which differs materially in detail from the locomotives in use on other mountain roads. The locomotive weighs 16.8 tons and is equipped with two 150 hp. 450 to 600-volt three-phase motors, running at 760 revolutions per minute. A speed of five miles per hour is maintained on both the up and down journeys. Special arrangements are provided for regulating the speed of the locomotive on the down grade—when disconnected from the line—between the normal speed and 5 per cent. of this. The motors work as asynchronous motors on the up journey, but they can be connected up as self-exciting generators on the down run. They have three slip rings on the one side and a commutator on the other. The three brushes belonging to the latter are automatically lifted off the commutator by a three-phase magnet whenever the line circuit is connected

up to the motors. A resistance, capable of absorbing 170 kilowatts for a lengthy period, is used both for starting and for braking.

To insure perfect safety three independent sets of brakes are provided, one operated by electricity, and controlled automatically, a second worked by hand and which applies bronze shoes to the driving axle of the locomotive, and a third, known as an emergency brake, which can be made to grip the rack.

As an example of what can be done in the way of mountain climbing by electricity, the Jungfrau railway stands foremost and will hold its own until some day a railway, which is now in contemplation, is built to the summit of Mont Blanc, the highest peak in Europe.

* * *

Artificial Gutta-Percha Cables.

Scientists, as is generally known, have long been seeking a substitute for rubber and gutta-percha. These two products which are a necessity to the electrical industry are becoming each year more difficult to procure and consequently more expensive. The substitutes so far brought out have usually left much to be desired after being subjected to a time test and it is therefore interesting to note, according to *Engineering*, London, that the German Telegraph Department has for nearly two years had some cables of artificial gutta-percha in use which, it is claimed, have so far given every satisfaction.

The material is the invention of Adolf Gentzsch, of Vienna, and is described as a mixture of rubber and a palm wax of the same melting point as the rubber. Electrically the product is considered equal to the natural gutta-percha, and it softens only above 60 degrees Centigrade, the mixture remaining homogeneous at these temperatures.

The cable in question is six miles in length and connects the Island of Fohr with Schleswig. It consists of four strands, each of seven copper wires, 0.6 mm. in thickness; with its covering of artificial gutta-percha, the diameter of each strand is 6 mm. (about ¼ inch), and the whole cable, with its jute and galvanized iron-wire sheathing, has a diameter of 36 mm. (1½ inches). The weight is 3½ tons per km. (about 5½ tons per mile). An insulation resistance of 500 megohms and a capacity of 0.15 microhm were guaranteed. The tests were made at temperatures between 30 degrees and —5 degrees Centigrade (86 and 23 degrees Fahrenheit), as the cables would be exposed to considerable temperature changes in the shallow water off the Frisian coast; an insulation resistance of 650 megohms was found, and the contract conditions were more than satisfied. The Gentzsch gutta-percha cables are 35 per cent. cheaper than gutta-percha cables. Although the artificial gutta-percha softens only at a higher temperature than the natural product, it is somewhat more sticky. Junctions and repairs are effected with the aid of Chatterton's compound and of natural gutta-percha. When the Fohr cable had successfully been laid, more cables were laid over to the Island of Norderney, in the mouths of the Ems and the Vistula, and at other spots in the North Sea and in the Baltic.

The total length of these cables is fifteen miles and as they are in exposed positions time will tell whether a successful substitute for gutta-percha has been discovered or whether another attempt will have to be credited to the already long list of failures.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The total amount thus far paid for the work on the underground road in New York is slightly in excess of $36,000,000.

The conversion of steam railways into electrically-driven roads is now going on rapidly throughout the United States, and an enormous amount of electrical work is practically in sight in this direction.

The Wall Street idea is that the Interborough Company of this city wants to lease the Metropolitan in some such way as it did the Manhattan—a 6 per cent. guaranteed dividend for a couple of years with the option of paying 7 per cent. if earned and after the time limit a fixed dividend of 7 per cent.

By absorption of parallel trolley roads and the electrifying of sections of the West Shore road the New York Central Railroad Company plans to make possible a journey from New York City to Buffalo in electric cars.

An American syndicate, headed by Edward F. Walker, has purchased the two street car systems in Monterey, Mex., embracing twenty miles of track, and will install electric power and merge them.

Manufacturers of carbide of calcium in this country and in Europe are trying to arrange a plan for a new price agreement. Until three months ago the price of carbide was controlled by an international syndicate. At that time the United Carbide Works of Nuremberg withdrew and the syndicate was dissolved. Since then, the manufacturers say, the trade has become demoralized by price cutting.

Machinery Day at the World's Fair has been set by the exhibitors for Saturday, September 3. The committee in charge, representing exhibitors in Machinery Hall and in the Steam, Gas and Fuels Building, is planning an elaborate programme for the entertainment of visitors on that day. In the evening a large reception with dancing will be given for invited guests, probably in the north entrance corridor of Machinery Hall.

A German paper states that the management of the water-power station at Schaffhausen intends to increase the capacity of the station by filling, during the night-time, a pond having a capacity of about 10,000,000 gallons with water from the Rhine. The pond is situated at a considerable height above the river, and the pumps are be actuated by synchronous motors, which, during the daytime, will be run as generators driven by turbines fed with water from the pond.

The cost of a ticket for the American Institute of Electrical Engineers special tour—leaving New York Tuesday, September 6, arriving at St. Louis September 11, remaining in that city during the sessions of the Electrical Congress, and returning to New York September 21—will be $150. This rate will include railroad fares, sleeping car berth, hotel accommodations (including accommodation at St. Louis), meals and all necessary expenses, but does not include hotel expenses in New York City or the expenses of the Boston trip, and does not include admission to the grounds of the Louisiana Purchase Exposition.

The first of thirty electric locomotives being built for the New York Central & Hudson River Railroad Company by the General Electric Company has been finished and will be given a test soon on one of the New York Central's freight tracks near Schenectady. The third rail system will be used. The locomotive is expected to go 100 miles an hour and exceed in power any steam locomotive on the road. This and 29 other locomotives of the same type are to be used in the Park avenue tunnel in New York City.

A new alloy for anti-friction metal and for brushes for dynamos is advocated in the *Elektrotechnischer Anzeiger* of Berlin. It consists of copper intersected with particles of graphite. A plate sprinkled with graphite is dipped into a copper bath, when the copper is deposited on the

plate and surrounds the graphite. The plate is then withdrawn, and again treated with graphite, after which it is reinserted into the bath, and the two actions are repeated until the diameter required is reached. It is said that the friction on metal so treated slowly releases the particles of graphite, which then act as a lubricant.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 79.*)

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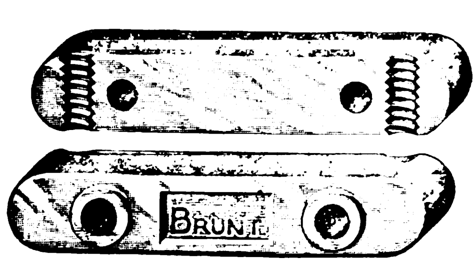

PORCELAIN CLEATS.

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Conduit Wiring.—The different kinds of wiring are included under the heads of

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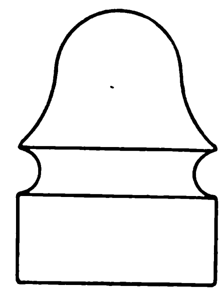
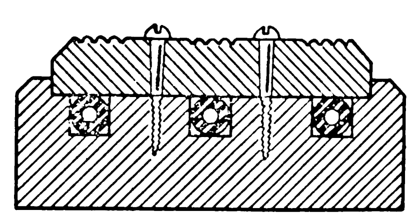


Knob Insulator

Cleat Carrying Wires



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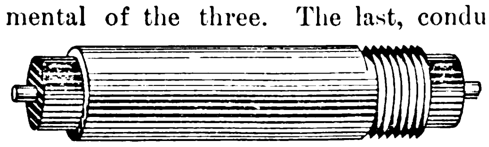

CONDUIT CARRYING INSULATED WIRE.

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The standard sizes of conduit are given with reference to the inside diameters of the different samples. The inside diameters of iron armored conduit as given by one of the foremost manufacturers are as follows:

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Inside Diameter.	Outside Diameter.
$\frac{7}{16}$	.675
$\frac{1}{2}$	.84
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$\frac{9}{10}$	1.31
$1\frac{1}{4}$	1.66
$1\frac{4}{10}$	1.90
$1\frac{8}{10}$	2.375
$2\frac{1}{4}$	2.875
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up to the motors. A resistance, capable of absorbing 170 kilowatts for a lengthy period, is used both for starting and for braking.

To insure perfect safety three independent sets of brakes are provided, one operated by electricity, and controlled automatically, a second worked by hand and which applies bronze shoes to the driving axle of the locomotive, and a third, known as an emergency brake, which can be made to grip the rack.

As an example of what can be done in the way of mountain climbing by electricity, the Jungfrau railway stands foremost and will hold its own until some day a railway, which is now in contemplation, is built to the summit of Mont Blanc, the highest peak in Europe.

* * *

Artificial Gutta-Percha Cables.

Scientists, as is generally known, have long been seeking a substitute for rubber and gutta-percha. These two products which are a necessity to the electrical industry are becoming each year more difficult to procure and consequently more expensive. The substitutes so far brought out have usually left much to be desired after being subjected to a time test and it is therefore interesting to note, according to *Engineering*, London, that the German Telegraph Department has for nearly two years had some cables of artificial gutta-percha in use which, it is claimed, have so far given every satisfaction.

The material is the invention of Adolf Gentzsch, of Vienna, and is described as a mixture of rubber and a palm wax of the same melting point as the rubber. Electrically the product is considered equal to the natural gutta-percha, and it softens only above 60 degrees Centigrade, the mixture remaining homogeneous at these temperatures.

The cable in question is six miles in length and connects the Island of Fohr with Schleswig. It consists of four strands, each of seven copper wires, 0.6 mm. in thickness; with its covering of artificial gutta-percha, the diameter of each strand is 6 mm. (about ¼ inch), and the whole cable, with its jute and galvanized iron-wire sheathing, has a diameter of 36 mm. (1½ inches). The weight is 3½ tons per km. (about 5½ tons per mile). An insulation resistance of 500 megohms and a capacity of 0.15 microhm were guaranteed. The tests were made at temperatures between 30 degrees and —5 degrees Centigrade (86 and 23 degrees Fahrenheit), as the cables would be exposed to considerable temperature changes in the shallow water off the Frisian coast; an insulation resistance of 650 megohms was found, and the contract conditions were more than satisfied. The Gentzsch gutta-percha cables are 35 per cent. cheaper than gutta-percha cables. Although the artificial gutta-percha softens only at a higher temperature than the natural product, it is somewhat more sticky. Junctions and repairs are effected with the aid of Chatterton's compound and of natural gutta-percha. When the Fohr cable had successfully been laid, more cables were laid over to the Island of Norderney, in the mouths of the Ems and the Vistula, and at other spots in the North Sea and in the Baltic.

The total length of these cables is fifteen miles and as they are in exposed positions time will tell whether a successful substitute for gutta-percha has been discovered or whether another attempt will have to be credited to the already long list of failures.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The total amount thus far paid for the work on the underground road in New York is slightly in excess of $36,000,000.

The conversion of steam railways into electrically-driven roads is now going on rapidly throughout the United States, and an enormous amount of electrical work is practically in sight in this direction.

The Wall Street idea is that the Interborough Company of this city wants to lease the Metropolitan in some such way as it did the Manhattan—a 6 per cent. guaranteed dividend for a couple of years with the option of paying 7 per cent. if earned and after the time limit a fixed dividend of 7 per cent.

By absorption of parallel trolley roads and the electrifying of sections of the West Shore road the New York Central Railroad Company plans to make possible a journey from New York City to Buffalo in electric cars.

An American syndicate, headed by Edward F. Walker, has purchased the two street car systems in Monterey, Mex., embracing twenty miles of track, and will install electric power and merge them.

Manufacturers of carbide of calcium in this country and in Europe are trying to arrange a plan for a new price agreement. Until three months ago the price of carbide was controlled by an international syndicate. At that time the United Carbide Works of Nuremberg withdrew and the syndicate was dissolved. Since then, the manufacturers say, the trade has become demoralized by price cutting.

Machinery Day at the World's Fair has been set by the exhibitors for Saturday, September 3. The committee in charge, representing exhibitors in Machinery Hall and in the Steam, Gas and Fuels Building, is planning an elaborate programme for the entertainment of visitors on that day. In the evening a large reception with dancing will be given for invited guests, probably in the north entrance corridor of Machinery Hall.

A German paper states that the management of the water-power station at Schaffhausen intends to increase the capacity of the station by filling, during the night-time, a pond having a capacity of about 10,000,000 gallons with water from the Rhine. The pond is situated at a considerable height above the river, and the pumps are be actuated by synchronous motors, which, during the daytime, will be run as generators driven by turbines fed with water from the pond.

The cost of a ticket for the American Institute of Electrical Engineers special tour—leaving New York Tuesday, September 6, arriving at St. Louis September 11, remaining in that city during the sessions of the Electrical Congress, and returning to New York September 21—will be $150. This rate will include railroad fares, sleeping car berth, hotel accommodations (including accommodation at St. Louis), meals and all necessary expenses, but does not include hotel expenses in New York City or the expenses of the Boston trip, and does not include admission to the grounds of the Louisiana Purchase Exposition.

The first of thirty electric locomotives being built for the New York Central & Hudson River Railroad Company by the General Electric Company has been finished and will be given a test soon on one of the New York Central's freight tracks near Schenectady. The third rail system will be used. The locomotive is expected to go 100 miles an hour and exceed in power any steam locomotive on the road. This and 29 other locomotives of the same type are to be used in the Park avenue tunnel in New York City.

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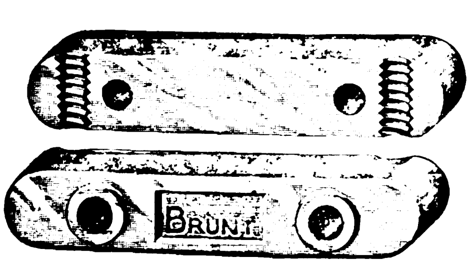

PORCELAIN CLEATS.

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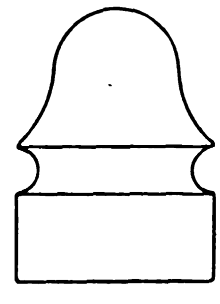

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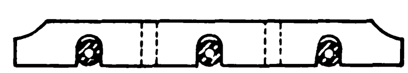
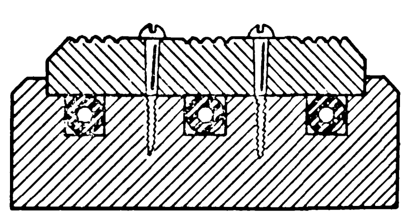


Cleat Carrying Wires



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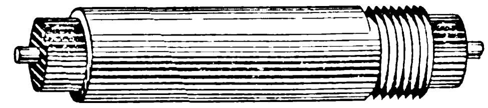

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The installation of a conduit system is practically equivalent to the equipment of a house with pipes, exposed or concealed as the case may be, through which wires are fished after the pipe work is completed. The necessity for using conduit of the correct size need hardly be commented upon. The greatest difficulty will be experienced if the pipes catch or grip the wires when they are fished through, and it is imperative therefore to only use the correct diameters, leaving nothing to chance in this respect. It occasionally happens in tall buildings that when mains or feeders are pulled through a conduit having several bends enormous force is necessary. This may be due to a kink in the wire or the bends or elbows in the pipe. A wire may slip through a pipe easily, yet catch if an elbow or two present themselves. A liberal allowance in pipe diameter will obviate this and save time and necessarily labor and expense if considered in advance in the wiring plans.

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$1\frac{8}{10}$	2.375
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This conduit is made of standard weight iron pipe and the same rules are followed in installing it that relate to wiring in general. Whenever different sizes of wire are to be connected a cutout must be installed and the circuits therefore radiate from or converge to panel boards. This is entirely in line with any other system of wiring whether knob, cleat or moulding. The iron armored conduit consists of iron pipe lined inside with insulating material, either a bushing or a composition in the form of a paint or enamel.

Enameled iron conduit is the name especially applied to iron pipe with an insulating enamel inside. As a general rule manufacturers guarantee that their product will bend without breaking or cracking the enamel. The inside and outside diameters are as follows:

ENAMELED IRON CONDUIT.

Standard size pipe. Inches.	Actual internal diameter. Inches.	Actual outside diameter. Inches.
½	.62	.84
¾	.82	1.05
1	1.04	1.31
1¼	1.38	1.66
1½	1.61	1.90
2	2.06	2.37
2½	2.46	2.87
3	3.06	3.50

The brass armored conduit consists of a composition of compressed paper saturated with an insulating solution and then protected on the outside with brass sheathing tightly embracing the inner thicker walled tube of conduit proper. The sizes of this material are as follows:

BRASS ARMORED CONDUIT.
Inside Diameter.

5/16 inch.
⅜ "
½ "
⅝ "
¾ "
1.0 "
1¼ "
1½ "

In choosing conduit for a job care must be made in the selection that the wire can be pulled through freely, otherwise great difficulty will be experienced when this point of the work is reached.

The asphaltic paper tube runs into smaller sizes than the others. It is called plain conduit and represents the first type of tubing employed years ago for the protection of wires as a substitute or equivalent for moulding. The sizes are as follows:

ASPHALTIC PAPER TUBE OR PLAIN CONDUIT.
Inside Diameter.

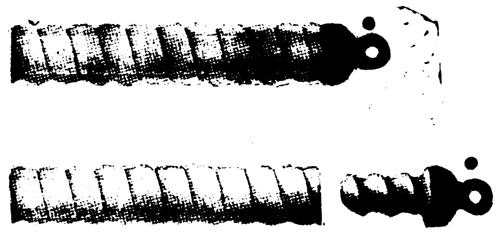
¼ inch.
5/16 "
⅜ "
⅝ "
¾ "
1 "
1¼ "
1½ "
2 "
2½ "

Unarmored like the above is the tubing called the American Circular Loom Conduit. It consists of woven insulating tubing, flexible in character and of great convenience in bridging over other circuits. It is used to a great extent for switchboard work and is extensively used for general wiring. Where wires are exposed and turns are to be made it finds ready application. Before the insurance laws became so far reaching and iron pipe was required, the flexible conduit enjoyed undisputed supremacy in the commercial field. The inside diameters are given in the following table:

FLEXIBLE WOVEN CONDUIT.
Inside Diameter.

¼ inch.
⅜ "
½ "
⅝ "
¾ "
1 "
1¼ "

In conjunction with the woven conduit there is also the flexible metallic conduit which is extensively employed in wiring.



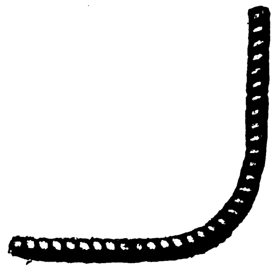
METHOD OF SECURING FLEXIBLE METALLIC CONDUIT.

The sizes as regards the inside diameters are as follows:

FLEXIBLE METALLIC CONDUIT.
Inside Diameter.

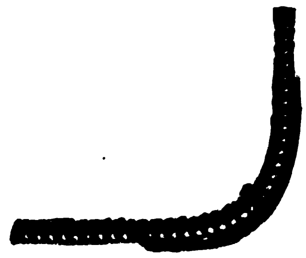
5/16 inch.
⅜ "
½ "
¾ "
1 "
1¼ "

With all metallic conduits whether flexible or not there is employed junction and outlet boxes. They are either round lined or square lined and serve for the purposes indicated by the names; either to allow wires to pass out for lamps, chandeliers, etc., in which case outlet boxes are used, or to act as boxes in which junctions are made between circuits, hence the title.



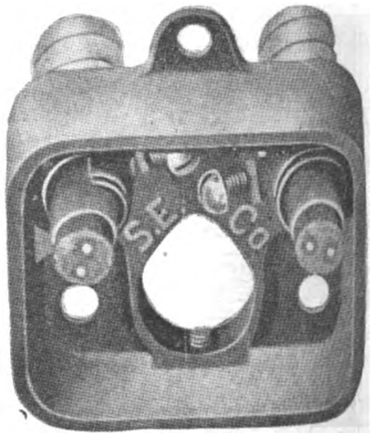
BEND.

COUPLING.

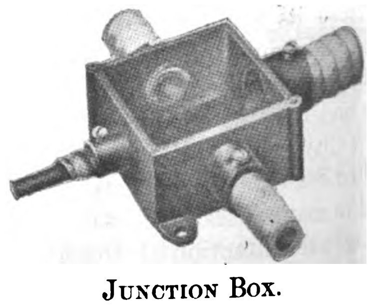


ELBOW CLAMP.

A unique combination of both wire and conduit in one has been introduced to the wiring world under the name of flexible steel-armored conductors. The purpose of this invention is primarily to develop



OUTLET BOX.



JUNCTION BOX.

a system by which wires can be installed where an ordinary conduit system would be a failure. The ease with which wiring can be installed when the conduc-

tors are so protected represents a saving in labor that relieves the problem of what might otherwise be regarded as unusual expense. Then in such cases where wires could not be safely or securely installed the application of this system becomes an absolute necessity. To quote from the manufacturers' catalogue "the flexible steel armored conductors are of special

FLEXIBLE STEEL ARMORED CONDUCTORS.

STEEL ARMORED FLEXIBLE CORD.

value for use under conditions, which would make difficult, if not impossible, the installation of a conduit system. The steel armor affords ample protection against ordinary mechanical injury, and conductors so armored can easily be drawn or fished into a building between partitions and under floors. In such cases no fastenings are required except at the outlets. When so installed, these conductors may be removed, if desired, as easily as the wires could be drawn from a conduit. The lead-covered, steel-armored conductors are of special value in damp places, such as breweries, dye houses, stables, etc., and are specially recommended with twin conductors for marine and underground work."

The conduit generally installed is held in place by means of fasteners or straps.

The lengths of conduit are joined together by couplings. When the flexible conductors are twin or three conductors their special adaptability for marine service becomes pronounced. They are generally made of stranded wires, that is, many fine wires together to give flexibility to the conductor. The sizes are as follows:

FLEXIBLE STEEL ARMORED (SIZES).

Twin.	Marine work.	Single conductor.
14	14 Twin.	10
12	12 "	8
10	10 "	6
8		4
6		2
		1

The couplings for ordinary conduit work run through a variety of sizes extending from ¼ up, depending on the character of the conduit, whether iron armored, brass armored or flexible, etc. In addition, elbows are employed where bends or turns are to be made. The various elements of a conduit system can be included under the following classification:

Character of Conduit.	Accessories.
Iron armored.	Iron elbows.
	Iron couplings.
	Plugs.
	Lock nuts.
	Tees.
	Caps.
	Malleable iron unions.
	Straps.
Brass armored.	Elbows.
	Couplings.
	Straps.
Plain unarmored.	Elbows.
	Couplings.
	Straps.

The flexible metallic conduit system calls for about the same accessories as the iron armored, the only difference being the flexibility of one in contrast with the other, and therefore the absence of elbows. Whenever special devices are to be employed, the manufacturers are only too happy to give full information and, if necessary, to make such changes or improvements as are required. Each conduit system calls for a special set of tools and it is necessary to possess experience and skill to properly install a conduit system and handle the tools relating to it. The time allowed for installing a conduit system of the concealed type is necessarily limited by the fact that the plasterers follow the electrical workers. Such being the case little time is left to rectify mistakes; should they be discovered after the plaster has been laid the contractor will be put to considerable expense. In many important cases the plans are either drawn up or at least vised by a competent consulting engineer to facilitate the completion of the work and rest the responsibility for it.

TESTS OF STEEL FOR ELECTRIC CONDUCTIVITY, WITH SPECIAL REFERENCE TO CONDUCTOR RAILS.*

BY J. A. CAPP.

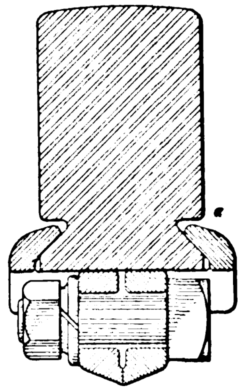
For certain classes of electric railways a steel conductor is preferable to the older and more commonly used overhead trolley wire. The third-rail presents a rather better appearance, because of the absence of an overhead structure; it is easily installed, cheaply maintained, presents a large area for conducting and collecting the current, and is particularly well adapted for high speed and heavy service. With costs calculated on the basis of equal conductivity in rail and trolley wire, the third-rail construction is cheaper than the overhead trolley. But the average interurban road will use a trolley wire of considerably less conductivity than would be obtained with the smallest size steel rail (about 60 lbs. per yard) that would ordinarily be used, and here the first cost of trolley construction would generally be less than that of the third-rail. While no third-rail installation has yet been in operation long enough to give figures of value, it would appear that the cost of maintenance of the third-rail construction should be less than that of the overhead trolley. This consideration, together with that of sightliness and adaptability (particularly in the case of terminals, yards and very heavy or high speed service) will frequently offset the higher cost of the third-rail construction and make it the preferable means of conducting the current from the generator to the car motor. For the first third-rail installations old track rails were used when obtainable, and these old rails were supplemented with new rails of standard T-section and composition. With the coming of the heavy high-speed service during the last few years, the resistance of these old and new standard T-rails was found to be so high that they would not carry the high currents necessary without too great a drop in the line potential. The rails would, therefore, have to be supplemented with additional copper feeders, but as this would be an expensive way to overcome the trouble rails of a higher specific electric conductivity were sought.

Because of the lack of specific data on the relation between conductivity and composition of mild steels, specifications for conductor rails have usually been based on the fact that the conductivity of a metal is generally more or less directly

*Abstract of paper read before the American Institute of Mining Engineers.

in proportion to its purity. In most cases the purity of the iron specified for such rails has been so high that not only was it difficult to obtain, but the iron was also correspondingly costly. One of the factors governing the choice between a third rail and a trolley wire is the relative price of steel and copper, allowance being made for the difference in conductivity. Hence, a balance must be struck between high conductivity (which is equivalent to saying a high degree of purity or freedom from the usual metalloids associated with iron) and the cost of producing the steel of the composition necessary for the conductivity required. With the object of drafting a rational specification for such third-rail steel, a series of tests was started some time ago in the testing laboratory of the General Electric Company on steels of as wide a range of composition as could be obtained from the steel makers, the results of these tests forming the basis of this paper. When entering the market with an order for rails of special composition, difficulty was encountered in interesting rail makers, and the reason became apparent. The mills which make the standard T-rails, or standard rails of other sections (such as the girder and grooved rails) have generally been designed with the object of making such rails only, and practice throughout has been standardized to the greatest possible extent, both in the manipulation of the steel and in its manufacture in the furnace or converter. Hence, an order, even of considerable extent, for rails of special composition, has so upset the routine work that it was considered a nuisance to be endured, rather than a desirable business to be sought for. Obviously, then, recourse must be had to mills where such special compositions can be handled economically.

The T-section of rail was the outcome of designs intended to present the greatest life and strength of the section, with the least weight of the metal, conditions necessarily to be met in a running rail. But the conditions for the third or conductor rail are different; here there must be provided sufficient current and cross section ample to carry the current without an undue drop in the line potential. The strength of the section is of little moment, and any section which is easily installed in an insulator is satisfactory. This permits the use of sections rectangular, or nearly so, which may be rolled easily in any mill equipped for the rolling of merchant-bar shapes of reasonably heavy weight without any change in equipment or practice beyond the provision of grooved rails of the necessary shape. Mills rolling merchant-bar or structural steel to-day are generally equipped to make steel in the open-hearth furnace, which readily lends itself to the making of steel of the special composition demanded by the electrical engineers for the third or conductor rail. Having these facts in mind, a section of a conductor rail has been designed by W. B. Potter, chief engineer of the railway department of the General Electric Company, which, when 2.5 inches wide by 4 inches high,



Cross-Section of New Conductor Rail—2 5in. wide, 4in. high and 98lb. per yard.

will weigh about 98 lbs. to the yard. This shape may be easily rolled in any merchant-bar mill heavy enough to attempt sections of this weight. A dove-tail at the bottom provides an easy means of securing the rails by fish-plates of special forms, and any of the common forms of bond may easily be applied. Ordered in lots of 1,000 tons or more such a rail should cost no more than a plain rectangle of equal weight.

To provide steels of sufficient range to give some indication of the relation between conductivity and composition we obtained from as many of the steel makers as we could interest samples representing all of their common products. Some of the makers kindly provided us also with samples of special steels made in crucible charges. The samples were mainly forged or rolled bars of from 1 inch to 2.5 inches in diameter, and from them were turned bars of 0.75 inch in diameter, or 1 inch in diameter by 24 inches in length, on which resistivity was determined. The chips from the finishing cuts were collected and these furnished the samples for analysis. We also cut similar bars from the heads of T-rails which were to be found in the yard tracks. Table I states the electrical resistance and the chemical composition of some of the samples of steel, wrought or refined iron. Samples Nos. 1, 2, 3, 4, 5 and 6 are standard T-rails from several well-known makers, while Nos. 9 and 10 are cut from the 100-lb. T-rail used for the conductor on the Aurora, Elgin & Chicago Railroad. No. 19 is a T-rail used by the Underground Electric Railway Company of London and ordered from a steel maker in Westphalia. Samples Nos. 20, 21 and 22 are ordinary refined bar iron, while Nos. 23 and 24 are special brands of refined bar iron sold for use in stay-bolts and similar work. Nos. 25 and 26 are Swedish and Norway irons respectively. The second column gives the resistance of the samples compared with Matthiessen's copper as unity, the temperature at which the measurements were made being near 20 deg. C. in all cases. The second half of the table gives the percentages of the usual elements to be found in steel or iron, the total percentage of these elements and the sum of

Table I.—*Resistance and Composition of Steel.*

Serial number.	Resistance.	Percentage composition						
	Cu=1.	C.	Mn.	P.	S.	Si.	Total. Not Fe.	P.+S.+Si.
1	13·20	0·33	1·27	0·09	0·05	0·05	1·79	0·19
2	12·12	0·17	1·09	0·09	0·05	0·004	1·404	0·144
3	11·55	0·20	0·95	0·10	0 08	0·05	1 38	0·23
4	11·51	0·22	1·08	0·10	0·05	0·06	1·510	0·210
5	10·04	0·36	0·87	0·08	0·09	0·04	1·44	0·21
6	9·94	0·37	0·73	0·09	0·04	0·06	1·29	0·19
7	9 48	0·23	0·89	0·058	0 01	0·005	1·193	0·073
8	9·36	0·16	0·66	0·074	0·030	0·014	0·938	0·118
9	8·42	0·144	0·46	0·09	0·08	tr.	0·774	0·17
10	8 36	0·188	0·48	0 09	0 08	tr.	0·83	0·17
11	8·06	0·16	0·48	0 091	0 04	0·01	0·781	0·144
12	8·04	0·10	0·55	0·08	0 05	0·024	0·804	0·154
13	7·92	0 10	0·25	0·04	0·02	0·05	0·46	0·11
14	7·70	0·27	0·41	0·024	0·01	0·001	0·715	0·035
15	7 66	0·28	0·28	0·027	0·034	0·04	0·661	0·111
16	7·40	0·15	0·45	0·011	0·033	tr.	0·644	0·044
17	7·38	0·19	0·21	0·025	0·04	0·034	0·499	0·099
18	7·28	0·215	0·22	0·051	0·113	..	0·599	0·164
19	6·40	0·05	0·19	0·054	0·059	0·03	0·383	0·143
20	7·82	0·15	0·068	0·13	0·02	0·15	0·518	0·30
21	7·48	0·15	0·064	0·036	0·02	0·13	0·400	0·186
22	7·41	0·16	0·074	0·12	0·027	0·10	0·481	0·247
23	7·11	0·08	nil	0·13	0·008	0·024	0·242	0·162
24	6·76	0·17	0·027	0 074	0·022	0·077	0·370	0·173
25	6·17	0·058	0·10	0 014	tr.	0·012	0·184	0·026
26	6·12	0·16	0·018	0·049	0·011	0·015	0·252	0·075

the percentages of phosphorus, sulphur and silicon.

A study of the table shows that manganese preponderates in influencing the resistance of steels, and that for lowest resistivity this element must be present in very small quantity, much smaller than is usual in merchant or structural steels. While all the other elements must be present only in very small percentages so great is the preponderance of the influence of manganese that they may be tolerated in quantities which the steel makers would consider reasonable, without unduly increasing the resistance. For a satisfactory third-rail the lowest possible resistance (from 6 to 6.5 times that of copper) is not necessary; and the great cost of making such extremely pure steel is not warranted; in fact, such extremely pure steels would probably be so soft that the frictional wear of the collecting shoe would be excessive and the life of the rail in service unduly short. Assuming, then, that a rail made from steel having a resistance not greater than eight times that of copper (13.8 microhms at 20 deg. C.) would be desirable for conductor rails, the figures tabulated would seem to indicate that the following extreme composition would be permissible—carbon up to 0.2 per cent., manganese up to 0.4 per cent., phosphorus up to 0.06 per cent., sulphur up to 0.06 per cent., silicon up to 0.05 per cent.

This composition, however, would be extreme, and any over-stepping of bonds might result in too great a resistance; therefore, for resistance up to eight times that of copper, the specified analysis should be—carbon not to exceed 0.15 per cent., manganese not to exceed 0.30 per cent., phosphorus not to exceed 0.06 per cent., sulphur not to exceed 0.06 per cent., silicon not to exceed 0.05 per cent.

This latter composition is one which could be made easily in any open-hearth furnace, and it should present no difficulty in rolling to a shape suitable for conductor rails. In fact, steel of this composition has been successfully rolled into sheets as thin as 0.014 inch, a size which was for a long time a standard product of a large sheet mill.

Electric Postoffice Vans.

Electrically operated vans are to be employed in Paris for conveyance of mails between the postoffices and the railway stations. The vans are designed to carry 1,200 lbs. at about 12 miles an hour, as compared with 8 miles attained by horse-driven vehicles. Each is equipped with 44 batteries and is able to cover 25 miles on one charge.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

A TESTING DEVICE.

In central-station practice it is necessary to be able to locate open circuits and grounds where a magneto has not given satisfactory results. Take enough lamps to take up the line voltage on which operates the machine or apparatus to be tested, and place them in series with one side of the line. Take a tap from the other side of the line, then with the live open ends, test as with a magneto. The number of amperes is regulated by the size of the lamps used.

W. J. Hugo, Madison, Wis.

A HANDY METHOD OF DETERMINING SIDE OF THREE-WIRE SYSTEM ON WHICH A TWO-WIRE METER LOOP IS ATTACHED

In order to maintain an accurate record of the connected load on a three-wire Edison system, it is necessary to know on which side of the system each meter is set. In a large building in which there is a three-wire system this may be determined as follows:

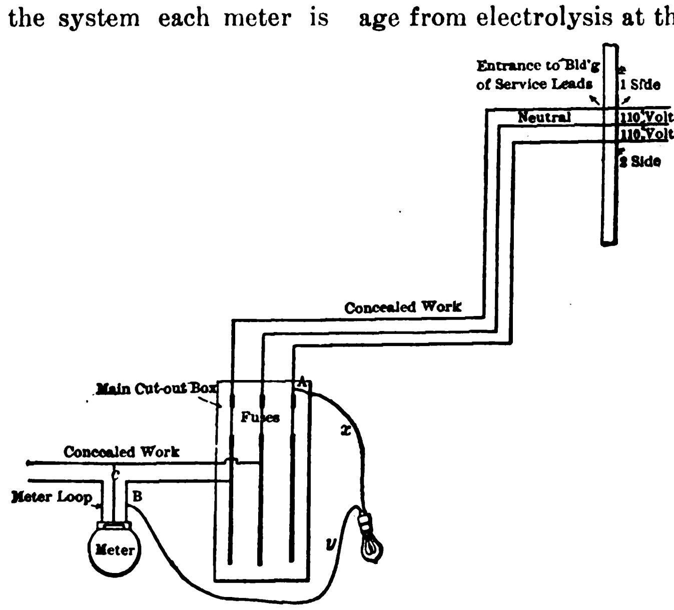


Diagram of Apparatus.

Assuming that, according to underwriters' rules, the wires of 220-110 volt three-wire Edison system in a building do not cross after entering a building, that is, remain in the same relative position as the service wires, from the place of entrance to building to main cut-out in meter-room, the side on which the meter loop is placed may be easily determined as follows:

Apparatus necessary: a 110-volt incandescent lamp, socket, and two short pieces of lamp cord connected to socket as leads. Attach one lead x (see sketch) to one side of line A at main cut-out; touch quickly the other lead y to line side of meter loop B; if lamp does not light, the meter loop is on same side of circuit as the first lead; if it burns brightly, the loop is on the other side of the circuit.

By touching the second lead y to the pressure wire c, whether or not the proper voltage of the pressure connection is obtained, is easily determined. This eliminates any possibility of burning up pressure coils of a meter due to wrong voltage.

G. W. Faller, Madison, Wis.

METHOD OF FIRE-PROOFING HIGH-TENSION CABLES IN MANHOLES.

High-tension cables in manholes, unless protected by some fireproof covering, are likely to be damaged in case of a manhole fire. When these cables are allowed to rest on iron brackets and where they are of considerable length and there is no break in the lead sheath of the cables there is liable also to be considerable damage from electrolysis at the point of contact between the lead sheath and the iron bracket. The Chicago Edison Company is now using split clay tile for covering these cables in manholes in all cases where it is practicable. Two light angle irons are installed to carry the weight of the cable and the tile, and from the end of the angle iron to the ducts a piece of light galvanized sheet iron is used to support the tile until the cement has had time to set.

Forty-five degree elbows are used for covering the bends on the cable. This method of covering the cable is expensive, costing in the case of a run of six cables, three on each side of the manhole, about $35 per manhole. It is, however, as near a fireproof job as can be obtained, and experience has shown that the fireproofing of all high-tension lines that

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston, Mass., May 24-27, 1904.

may carry several thousand kilowatts each is of vital importance.

Where there are only one or two cables in a manhole and where it is not possible to use split tile on account of the way the cable is trained, we use two layers of heavy asbestos paper for a protection. This paper is held in place by brass tape 1 inch wide and .025 inch thick, the tape being wrapped close together so that the asbestos can not disintegrate from the effects of water or other causes.

W. G. CARLTON, Chicago, Ill.

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AN EFFECTIVE TELEPHONE GONG.

In electric plants where the noise of the machinery would drown the ring of the bell on a telephone the above scheme may be used to notify the subscriber that he is wanted at the telephone.

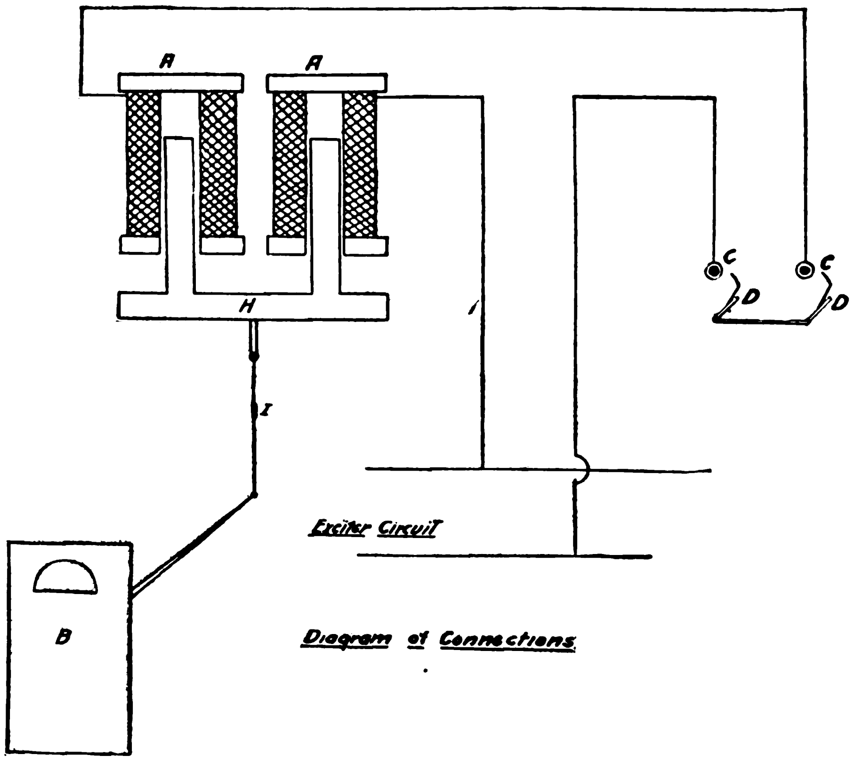
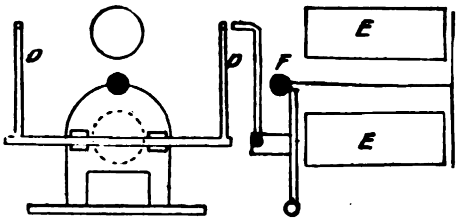


Diagram of Connections



Detail of Connectors and ringing set

The apparatus consists of a pair of electromagnets AA with soft-iron armature H, a steam whistle B, two mercury cups CC, two curved connectors DD, a bell-ringing set from a telephone.

The ringing set is inserted in the circuit between CC and DD.

When central calls the subscriber the bell clapper F begins to move up and down; on the up stroke the framework attached to the curved connector is released, falling in the mercury cups, thereby closing the circuit. This causes current to flow through the coils AA, pull up the armature H, which in turn pulls the lever opening inlet steam valve to whistle. The announcement of the whistle calls subscriber to 'phone, the whistle continuing to blow until the jack which the curved connectors are soldered in again thrown behind the clapper F.

The current is obtained from a 150-volt exciter circuit supplied by a 25 kw. dynamo, and the electromagnets were taken from a Brush lamp, being rewound to suit this voltage.

A precaution must be observed in that an insulator I of some kind is placed between the armature H and whistle, to insure safety in case the magnet winding becomes grounded on its frame.

GEORGE CUSHMAN, San Antonio, Tex.

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ARRANGEMENT FOR SERIES ARC CIRCUITS.

It is convenient where possible to have "jumper switches" or some equivalent installed where portions of the same circuit come near each other, as at the beginning and end of a loop. The switch or device so arranged that by closing it the loop can be short-circircited. If the line opens, a man can be sent around and close the switches one at a time, and in a comparatively short time the loop in which the open circuit is will be discovered. The loop may then be entirely disconnected and the rest of the circuit operated until the break is repaired, when the switch may be opened. If the number of lamps on the circuit is too many it may not be possible to do this when the circuit is "alive," on account of the high voltage involved.

GEORGE B. LAUDER, Concord, N. H.

Electric Canal Haulage.

According to statements from Columbus, O., a complete plan has been agreed upon whereby the Miami & Erie Canal Transportation Company will be reorganized for the purpose of going into the business of electric canal haulage between Dayton and Cincinnati.

LETTER FROM AN OLD HAND TO A YOUNG ONE ON THE CHOICE OF ENGINEERING.*

My Dear Young 'Un.—Your letter of yesterday's date to hand, announcing that you "have decided to become an Electrical Engineer." Why use capitals? There is nowadays no more common noun than "engineer;" anyone from a bellhanger to a wireless telegraphist is electrical. Thanks for giving me early notice of competition. It is the age of young men, and we, products of effete training systems, have only our experience to rely on. Or is your letter a gentle hint that you want me to find you a job?

I am going to take the privilege of a friend—to make myself disliked—by offering that which the clergy call "a word in season." Have you *decided on*, or only *fancied*, engineering? Most fellows between the ages of 15 and 19 are attacked by "calf-love." They pick up some girl to whom they write verses, waft kisses, and swear evermore to be faithful. And between the ages of 24 and 42 they usually marry—some other girl! Are you sure that engineering is not your calf-love among the professions? Let me assure you that picking a wife and choosing a profession are the two most appalling jobs a man has to go through. Generally speaking, the biggest fool chooses in the biggest hurry. Of the two choices, that of a profession is perhaps the most serious. When you marry there is always the off-chance of a separation; but if you give your profession the go-by, you must start life again.

*From the "Electrical Engineer," London.

Unless you care enough for engineering to say that for the love of her you will be satisfied if she gives you, in return for hard days of work and long evenings of study, just enough to live on decently, you had better go bank-clerking or butter-slapping.

Look at it this way: In an average engineering firm the number of men who get enough to pay income tax will not exceed 5 per cent. of the whole crowd; if it did, the firm would be all head and no tail. The bulk of the 95 per cent. are probably keeping wives and families and wishing they had never been born. Or look at it another way: The technical colleges are every year turning out crowds of energetic youngsters, chock-full of theory, willing to work for experience and 5s. a week in an already over-crowded labor market. In addition to these are the shoals of youths who start as apprentices, pupils, improvers, or anything else in the cub stage you like to call them. Or, take a look at the *Gazette*—it is healthy reading occasionally—and tote up the number of small engineers who go to pot every year. Of course, I know you are a smart boy, and have honest intentions of becoming president of the Institution of Civil Engineers. But suppose you don't?

A friend of mine once had a craze for railway engineering. He had family influence with the chief engineer of one of the lines, and so he felt sure of a soft berth. One of the first questions fired at him by the great man was, "Have you ever built yourself a wheelbarrow?" to which he had to answer "No!" "Or a model yacht?" "No!" Whereupon the chief intimated that the applicant would be of no condemned service to any railway company, and requested the honor of his absence. Only the manner of speaking was more abrupt. My friend took the hint, became an estate agent, and can now buy himself a fancy waistcoat without docking his laundry bill.

That is the test! If you *can't help* using your hands—if you as a kid tied all the chairs together with string and sewing cotton spools to make the wheels go round, and cut yourself with the carving knife making a boat—then you are an engineer. If you didn't, you aren't. If you aren't, don't try to be; there are plenty who are. You have only one life to live, and you might as well live it according to your instincts.

Another point: If you have any recollection of past mercies, you will remember that last winter I took you to the theater. There was a fearful crowd round the door when we got there, but we edged round, and by paying a little extra we went in and got a front seat. I lay this before you as a parable. Assuming that you *are* an engineer, why should you be electrical? I trust you don't bet—bad habit for tender years—but if you meet an engineer, you can lay 6 to 1 that he is electrical. Why?

It has apparently slipped the notice of many young fellows that they can become hydraulic engineers, shipbuilders, bridge and roof constructors, motorcar makers, quite as easily as electricians. If you are wise, and have no overpowering aptitude (I don't say inclination) for electrical affairs, you will keep out of the crush and get your position by the early doors. The only extra expense is a little more thought in making the first choice. Believe me, present-day electrical engineering is by no means Tom Tiddler's ground, whatever it may have been.

If, after all, you decide to be an electrical engineer, put your back into it. Don't hesitate to soil your lily-white hands, and don't be happy till they've grown corns where the blisters were. And—if you will take a word in confidence—you had better throw up that girl who is making a fool of you and buy "Dynamo-Electric Machinery." You haven't time for both.

You might as well write and let me know what you are going to do, for there is no need for you to break your shins on exactly the same rocks that I met.

Yours, THE OLD 'UN.

International Electrical Congress.

Dr. A. E. Kennelly, general secretary of the committee of organization of the International Electrical Congress, has issued the following circular:

"The International Electrical Congress will convene at the Music Hall of the Coliseum, St. Louis, at 9:30 A.M. on Monday, September 12. The Music Hall is situated at Olive and 13th streets, in the city district of St. Louis. All Congress members are invited to attend the meeting.

"It is intended that after the opening ceremonies, the convention will immediately divide into sections, the section halls being on the second floor of the same building. The bureau of information and the offices of the secretary and treasurer will also be in the Coliseum Building. On Tuesday, Thursday and Friday the sections will meet on the second floor of the Coliseum from 9 A.M. to 1 P.M.

"The committee of organization of the Congress was appointed by the president of the St. Louis Exposition in June, 1903. The committee held its first meeting in August, 1903. In response to invitations to join the Congress, 1,915 acceptances have been received, of which 1,542 are from North America and 373 from other countries. Over 1,300 certificates of membership have been issued to persons who have already become members by forwarding their subscriptions.

"The committee of organization has issued at the suggestion of the section officers invitations to well-known electrical workers all over the world, asking for papers to be read before the Congress. In response to these invitations, about 170 papers have been promised for the Congress, and 67 are already in hand."

The Edison Illuminating Companies' Convention.

As previously announced in ELECTRICITY the 25th convention of the Association of Edison Illuminating Companies will be held at the Hotel Wentworth, New Castle, N. H., commencing Tuesday, August 30, at 9:30 A. M.

Mr. Wilson S. Howell, the assistant secretary of the organization, informs us that the following papers will be read:

"A Plea for Uniformity in Construction and Operation of High-Tension Systems," Philip Torchio.

"Notes on Economy in the Production of Steam," W. F. Wells.

"Experiences with Automobile Charging Stations," Joseph W. Cowles.

"Vulnerable Points in Operation of High-Pressure Alternating Transmission, Supplying Large Distributing Systems," D. L. Huntington.

"The Relative Efficiency of Electric and Hydraulic Elevators," W. C. L. Eglin.

"Electric Heating and Cooking," H. W. Hillman.

"Relations between Length of Arc, Voltage and Candle-Power in Inclosed Arc Lamps, and the Effect upon Efficiency of Arc Lamps by Varying Size of Carbons," George N. Eastman.

"Gas Engines vs. Electric Motors," Frederick M. Kimball.

"Light and Illuminating Engineering," W. D' A. Ryan.

"To What Extent Should Central Stations Make Investments?" John F. Gilchrist.

"Results Up to Date Obtained from the Use of the Wright Demand System of Charging," John W. Ferguson.

"Some Commercial Problems," Joseph D. Israel.

"Notes on European Testing Laboratories," Dr. Clayton H. Sharp.

"Results Up to Date Obtained From

the Use of the Wright Demand System of Charging," Arthur S. Knight.

"Measuring Instruments in Generating and Substations," Caryl D. Haskins.

"Troubles and Losses Between Generators and Customer's Services," P. Junkersfeld.

"Some Data on Electric Power," Arthur Williams.

Largest Wireless Telegraph Station.

U. S. Consul General Guenther, at Frankfort, Germany, has communicated to the State Department at Washington details of the largest wireless telegraph station in the world, to be erected at Pisa, Italy.

The station will be called Coltano, and it is designed to establish wireless telegraphic communication from Pisa with Great Britain, Holland, the United States and Canada, as also with vessels in the Mediterranean, the Baltic Sea, the Red Sea and the Atlantic and Indian oceans. The buildings will be of the most approved style and constructed entirely of stone.

The Berlin-Hamburg Electric Road.

The projected electric railway between Berlin and Hamburg will cost 70,000,000 marks, single track, and 105,000,000 marks double track. The distance is to be covered in an hour and fifty-five minutes. It is estimated that 650,000 passengers a year could be safely counted on, and a single track road would pay expenses if there were only 520,000; for a double track 850,000 would be required.

Proposals Invited.

The Bureau of Supplies and Accounts of the Navy Department at Washington, D. C., is inviting sealed proposals until August 30, as follows: For furnishing the Navy Yards at League Island and Washington with electrical supplies, rubber-covered wire, slate panel, motors. For furnishing the Navy Yards at Boston, Portsmouth and Newport with dry battery cells, fuses, fuse wire, transformers, switchboard, arc lamps, lightning arresters, poles and fixtures. September 6: For furnishing the Navy Yards at Mare Island and Puget Sound with incandescent lamps, carbons and miscellaneous electrical supplies. Blank proposals for the above can be obtained at the navy pay offices in the cities named and on application to the Bureau.

We regret to learn that Mr. Max Osterberg, consulting electrical engineer of this city, was recently taken dangerously ill with cerebral apoplexy, and that his physicians have doubts about his recovery.

THE CHURCHER ALTERNATING CURRENT RECTIFIER.

It is a well nigh settled fact that there is nothing absolutely new under the sun. To the ordinary observer it matters little how much study and hard work an inventor may have given his product before it becomes a marketable commodity and he is always ready to listen to the claims of invention by some one in the obscure past who had a vague idea in his head upon the subject. It always remains for some one to not only invent a device, but to put it into such a practical shape that it can be made a useful article to society and indirectly a producer of the "wherewith all" with which other useful articles may be made available.

It is not such a difficult matter to invent something new, comparatively speaking. Much hard work must be done, difficulties overcome, methods of manufacture and sale perfected before any real success is achieved. Such has been the case with the alternating current rectifier about which more or less has been written in the last few years. It is not a newly discovered fact that aluminum and some other metals have the faculty of developing upon their surfaces an insulating film when in contact with certain solutions and while electrically positive to another electrode in the same solution but it has remained in an unperfected state.

The Churcher Alternating Current Rectifier is a decided departure from anything before constructed and is now in marketable and practicable shape. The best that has been accomplished heretofore was a very inefficient and crude device. A single cell with a pair of suitable elements will rectify part of the cycle of an alternating current, but this is not a true uni-directional current. It is still an alternating current in character with one alternation of greater amplitude than the other and giving an efficiency of perhaps 20 per cent. when charging a storage battery.

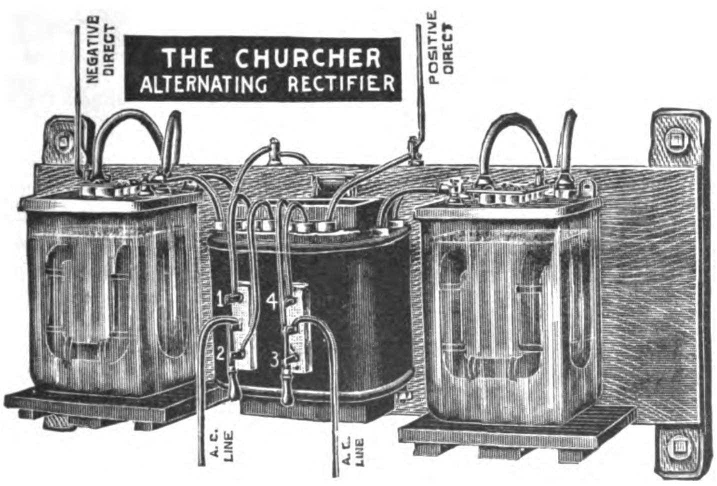
This poor result is partially caused by the return or leakage current passing through the rectifier and through the battery in the wrong direction, hence discharging it. To charge a storage battery under this condition it is evident that an excessive charging current must be used to overbalance the excessive discharge that takes place during one-half of the cycle. For example, in figures that are approximately correct, to charge a battery of cells aggregating 50 volts a potential of about 60 volts is ordinarily required. Supposing for illustration that this potential will pass 10 amperes through the cells on direct current circuit. In order to charge at this rate from an alternating current with a single old type rectifier it will be necessary to raise the charging potential sufficiently, say to 75 volts, to force 50 amperes through the cells, an excessive charge. This is because of the fact that the potential of the return wave of the alternation will be added to that of the battery and produce a serious leak through the insulating film on the aluminum electrode. The average discharge potential would be 50 plus 75 or 125 volts. Average, because at the peak of the alternation the actual potential would reach about 150 volts against the film which is approximately its break-down point. This high return potential as it may be termed will cause a discharge of about 40 amperes. an excessive discharge rate. This leaves a net charging current of 10 amperes. It is pre-supposed that a battery requiring 10 amperes would have capacity of about 100 ampere hours, and hence it will be seen that in order to charge at 10 amperes from the old type of rectifier it was necessary to charge at 50 and discharge at 40 amperes, leaving the required margin for charging. At this rate the rectifier would be rapidly destroyed and the best storage battery would be served likewise. A rectifier of that type is not worthy of further consideration as it is of no more real value for other purposes than for charging batteries.

The next step was the combination of four rectifying cells, known as the Graetz method of connection. This combination was somewhat better in that it rectified both waves of the cycle and hence gave a true uni-directional current. The efficiency was necessarily low because of the fact that the resistance in the path of the useful current was double and leakage was also double that of a single rectifier. The old type of single cell being inefficient to start with, the combination of four was nearly four times as bad, to say nothing of the wear and tear on four sets of electrodes and four solutions. The only gain was a really uni-directional current produced so that in charging a storage battery all of the energy passing through it was available for discharge, barring, of course, inherent losses peculiar to storage batteries.

The next step was the perfection of the Churcher Rectifier, manufactured by the Electrical Appliance Company of Cincinnati. This device rectifies both waves of any alternating current, and requires but one jar, one solution and one set of electrodes to do so. In this way the internal resistance is reduced to a very low point, in fact it is only limited by me-

chanical necessities to prevent short circuits. This loss is almost negligible. The principal loss that does take place is the leakage current. This current does not pass through the apparatus operated by rectified current but is expended in heating the solution. This loss is largely dependent upon the electrode potential at the film, the purity of the aluminum and solution and its temperature. Where continuous service is required of the rectifier it is therefore imperative to prevent this initial rise in temperature by the use of water cooling pipes or radiation of some sort.

This form of rectifier requires the use of a transformer with a secondary of twice the direct current voltage required plus the resistance loss. This secondary coil is tapped in the center, and by virtue of the action of the rectifier this tap remains positive at all times to one or the other extreme terminal. The active electrodes are attached to each of the extreme secondary terminals, the number depending upon the phase of the alternating supply. Owing to the peculiar properties of the films on these electrodes no appreciable current passes from either to the other. Electrodes of inactive material, such as platinum, carbon. etc., would short circuit the transformer. Between these active electrodes but insulated from them is placed an inactive electrode, preferably platinum. Connected between this electrode as one terminal and the center tap of the transformer as the other, is connected the battery to be charged, direct current motor or other apparatus to be operated. In operation the current passes from the center tap of the transformer to the motor, from the motor to the inactive electrode in the rectifier solution, to one or the other active electrodes depending on which is at that instant negative to the center of the transformer. Inside the rectifier the current therefore passes from the inactive electrode, first to one then to the other active electrode as the alternations of the cycle take place, the center of the transformer remaining positive at all times. It will be understood from this that one side of the transformer is active while the other is inactive and then reversed during the next alternation.



The regulation of direct current is best attained by placing an adjustable inductance between the transformer terminals and the active electrodes of the rectifier. This regulation can also be very efficiently attained by an inductance in the main alternating supply or by varying the number of turns of wire in the primary of the transformer. Either form of regulation is, of course, much more efficient than placing resistance in series with storage batteries when charging from 110 volt direct current mains. It is also a well-known fact that a pulsating unidirectional current is especially desirable for charging storage batteries. Just why it is so, is not very well understood, but the fact remains.

The practical limit of voltage of one cell of the Churcher Rectifier is about 50 volts direct current at full ampere load or a difference of potential across the active electrodes of about 130 volts. Somewhat higher voltage may be obtained under favorable condition, but the efficiency is generally much lower because of the in-increased leakage from one transformer terminal to the other. Through the use of two cells and two secondaries in the one transformer, twice the voltage can be obtained, three cells with three secondaries in the one transformer will give three times the voltage, etc.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 9, 1904.

Electric Railways and Appliances.

766,856. Electromagnetic Traction Device and Brake. Charles A. Wells, Chicago, Ill. Filed Dec. 10, 1903.

766,906. Street-Car Fender. Ernist H. Schulze, Kansas City, Mo. Filed Dec. 23, 1903.

766,935. Controller for Trolley-Poles. Herman R. De Long and Rector Seymour, Warren, Pa. Filed May 25, 1904.

766,952. Electrical Contact Device for Intermittently Establishing Circuits on Moving Cars. Jefferson D. Keen, Cincinnati, O., assignor to the Electric Indicator Company, Louisville, Ky. Filed March 18, 1904.

766,991. Propelling Railway-Cars by Synchronous Electric Motors. Alexander Churchward, New York City, assignor to the General Electric Company. Filed Oct. 11, 1902.

766,999. Car-Fender. Henry W. Howe, Mexico, Mex. Filed Feb 24, 1904.

767,018. Trolley-Stand. Bruno Stenvall, New York City. Filed Nov. 10, 1903.

767,025. Trolley-Base and Pole or Arm Therefor. George Volker, Albert W. Goerlitz and August Goerlitz, Buffalo, N. Y. Filed Oct 16, 1903.

767,190. Electrical Signaling Device for Railroad-Crossings. Joseph Weinschenck and Clifford H. Blodgett, Durand, Mich. Filed Jan. 14, 1904.

767,256. Electric Semaphore-Signal Mechanism. Bruno O. Wagner, Amsterdam, N. Y., assignor to the Magneto Electric Company, Incorporated, same place. Filed May 7, 1903.

Electric Lights and Appliances.

766,824. Regulator for Alternating Series of Arc-Light Systems. Josef H. Hallberg, New York City, assignor to the General Incandescent Arc Light Company of New York. Filed Jan. 29, 1902.

Electrical Machinery and Apparatus.

766,864. Electrical Street and Station Indicator. Lewis C. Allen, Pittsburg, Pa. Filed Dec. 7, 1903.

766,977. Variable-Speed Direct-Current Shunt-Motor. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company. Filed March 20, 1902.

767,052. Electric Switch. Arthur E. Handy, Providence, R. I., assignor to the Rhode Island Elevator & Machine Company, same place. Filed Aug. 29, 1903.

767,103. Electrical Converter. William B. Churcher, Cincinnati, O., assignor to Kennon Dunham, same place. Filed Sept. 21, 1903.

767,105. Magnetic Separator. Myron Dings, Milwaukee, Wis. Filed Aug. 7, 1903.

767,154-155. Means for Regulating Electric Motors. Johan G. V. Lang, London, Eng., assignor of one-half to Edward Hibberd Johnson, same place. Filed Jan. 20, 1903, and Feb. 1, 1904.

767,163. Electric Switch Box or Case. George E. Neuberth, Newark, N. J. Filed Oct. 3, 1903.

Telephones and Telephone Apparatus.

766,821. Telephone-Transmitter. Auguste Gamache, East Clifton, Canada. Filed June 21, 1902.

766,929. Telephone Attachment. Frank R. Chamberlin and Raymond H. Coleman, Cleveland, O. Filed March 10, 1903.

766,945. Selective Telephone Call Mechanism. Henry I. Hawxhurst, East Oakland, Cal. Filed Sept. 5, 1902.

767,033. Telephone' Central-Exchange Installment, Richard M. Beard, New York City, assignor to the International District Telephone Company, same place. Filed Dec. 15, 1903.

767,284. Central Energy System. William M. Kelly and Geary E. Truxell, Greensburg, Pa. Filed May 20, 1903.

767,356. Telephone Order-Desk. John W. Schmidt Brooklyn, N. Y. Filed Dec. 16, 1903.

Miscellaneous.

766,806. Individual Selective System. Benjamin Brooks, Springfield, and Howard F. Metcalf, Holyoke, Mass. Filed Feb. 28, 1903.

766,810. Electric Hammer. Joseph Chambers and Corydon L. Cole, Minneapolis, Minn.; said Cole assignor to George J. Backus, same place. Filed April 25, 1904.

766,815. Primary Battery. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Manufacturing Company. Filed Nov. 18, 1903.

766,865. Locking Device for Electromagnets. William Baxter, Jr., Jersey City, N. J. assignor to the Otis Elevator Company. Filed Sept. 22, 1903.

767,002. Lightning-Arrester. Charles T. Mason, Sumter, S. C. Filed April 9, 1904.

767,015. Electric Therapeutic Machine. Harry A Slaughter, Los Angeles, Cal. Filed Oct. 22, 1903.

767,050 Electric Lock. Adalbert Haesner, Munich, Germany. Filed July 1, 1903.

767,110. Method of Making Magnetic Materials. Robert A. Hadfield, Sheffield, Eng. Filed June 18, 1904.

767,303. Telegraphic Transmitter. Horace G. Martin, Brooklyn, N. Y. Filed May 7, 1904.

767,316. Safety Device for Electrically-Propelled Vehicles. James H. Spencer, New York City. Filed April 13, 1900.

THE TELEPHONE WORLD.

Independents Still Increasing.

The growth of Independent telephony throughout Pennsylvania and the Union the past year or two has been very marked. In Philadelphia the Keystone Telephone Company has steadily advanced until it covers the entire city and the most of the suburban towns through a traffic arrangement with several Independent companies.

The Standard Telephone Company, operating chiefly in Bucks County, is practically a part of the Independent system, having direct connection with the Keystone of Philadelphia and affiliated companies throughout the State. With the completion of a line from Johnstown to Pittsburg, it will be possible to reach Chicago, Cincinnati, Cleveland and other cities in the West over the Independent lines.

Ohio Company Increases Capital.

The Citizen Telephone Company of Columbus, as announced in our last issue, filed a certificate with the Secretary of State, increasing the capital stock of the company from $750,000 to $1,250,000. The new issue is to be 6 per cent. preferred stock, upon which dividends are to be paid semi-annually. It is also to be preferred in case of insolvency. John Joyce signed the certificate as president of the company and Edwin R. Sharp as secretary.

The Franklin County Telephone Company of Columbus was incorporated a short time ago by Isaac B. Cameron, Seth L. McMillen, Ralph Reamer, Homer L. Rose and Charles F. Johnson. The company proposes to operate telephones connecting Westerville, Gahanna, Worthington, Galloway, Groveport, New Albany, Dublin, Black Lick, Brice, and a number of other places. The incorporators are all connected with the Citizens' Telephone Company of Columbus.

President John Joyce has stated that the increase in the preferred stock of the Citizen Telephone Company was merely to afford sufficient funds with which to meet the extended improvements being made in introducing automatic switchboards, constructing a new building immediately to the south of the present structure on Third street, near Long, and the laying of underground conduits. He further said that the Franklin County Telephone Company has been owned and controlled by the Citizen Telephone Company for some time.

The question of establishing a Government-owned telephone system in the District of Columbia was discussed at a recent meeting of the Cabinet. The matter was brought up by the remark of one of the members that the rates for department telephones supplied by the Chesapeake & Potomac Telephone Company for the new fiscal year were higher than those submitted last year. There have been complaints for several years against the high prices the Government is obliged to pay for the extensive departmental telephone system in Washington, and it was agreed by the President and Cabinet that the whole matter be turned over to Secretary of the Navy Morton for investigation.

The contract has been let and work begun of building a telephone line from Bryan, Tex., nine miles northeast, to connect with a line to Henry, Prairie and Franklin, passing through Wheelock.

Big Independent Movement.

Ohio has been divided into nine districts by the executive committee of the Ohio Association of Independent Telephone Companies for organization and mutual working conditions. There was a meeting of the vice-presidents of the association at Columbus on August 8, when plans were laid for a thorough organization of the Independent telephone companies of the State.

Automatic Telephone Service for Windham, Me.

Windham will have the automatic telephone service within a short time, according to a recent statement made by General Manager Goudy of the Northeastern Telephone Company. The system is already nearly completed in the town of Gorham, and as soon as permission is received to enter the town of Windham, the new system will be installed in South Windham and other parts of the town.

The date of the hearing has not yet been fixed, but will probably take place about the 20th of this month, and work will be commenced on the line at once.

The central office will be stationed at the most convenient point, the station depending on the amount of business and that part of the town which furnishes the most of it. Branch lines will be built from the exchange to points wherever desired.

East Dubuque to Have Independent System.

The Tri-State Telephone Company is perfecting plans for the construction of a submarine cable for the extension of the line to East Dubuque, Ia. The work of building the cable has already been commenced at a Chicago factory and it will soon be completed. It will require 2,375 feet of submarine cable to span the river, besides 3,600 feet of aerial cable, which will be run from the river's banks to where the wires spread out in Dubuque and East Dubuque.

Doylestown, Pa., and other towns in Bucks County, are to share in concessions and improvements to be made by the Delaware & Atlantic Telephone Company. District Manager C. D. Avis was lately in the county seat, and gave an outline of the work done and what is to be done. Mr. Avis says that the underground system will be installed in Doylestown before cold weather, and that very soon the common battery system will be installed. All the material is there to go ahead with the work, which will include the furnishing of the new office on State street. One of the principal concessions is in rates, which will be much lower, giving unlimited service in Doylestown for a reasonable sum, and under certain conditions allowing a certain amount of outside tolls.

A new rural telephone line is in course of construction from Lake Preston, S. D., to the territory north and west of the town. It is said another line will be built to the farming community west and south. The new lines will bring a large number of farmers into direct communication with business men in Lake Preston.

Connections have been established in Rushford, Minn., with the twin cities over the Independent telephone lines.

An Interocean Telephone System.

Recent reports from Austin, Tex., state that the Huntington Syndicate of California, which a few months ago acquired several hundred miles of long-distance telephone lines in Texas, is rapidly carrying out its plans for a through long-distance telephone line between the Atlantic seaboard and the Pacific coast. The southern route will be followed.

The acquired lines in Louisiana and Texas and the existing lines in California leave a gap of 600 miles in Texas between San Antonio and El Paso and all of New Mexico and Arizona to be filled in. The syndicate is closing negotiations for the purchase of Independent long distance lines through Arizona and New Mexico, and when this is done about 800 miles of wire will have to be put up for a through connection between Los Angeles and New Orleans.

Connecting lines will be built northward all along the main system.

Cuyahoga Company's Injunction Suit.

An injunction suit has been brought by the Cuyahoga Telephone Company of Cleveland, O., against the Dime Savings and Banking Company of that city, to prevent its further refusal to issue $167,000 bonds under an agreement when an issue of $3,500,000 was arranged. The bank was made trustee for the bonds. At the time $2,000,000 was issued and $100,000 more was to be issued when the first 1,000 telephones above 5,760 were put in operation. The next 1,000 called for $133,000 and in the same proportion up until the issue was exhausted. The bank has refused to deliver the last lot called for on the ground that lines using the same circuit from the same trunk, but otherwise separate, are not single lines. The telephone company says that they are and must be so considered under the contract with the bank. The bank has filed a demurrer to the petition All the money from this bond issue has been used in constructing the plant and making extensions,

The United States Railway Signal & Telephone Company of St. Paul, Minn., has filed articles of incorporation with the Secretary of State. The company is capitalized for $1,000,000 and will make its principal business the manufacture of the Johnson-Ballard electric signals and supplies.

At the regular monthly meeting of the Langhorne, Pa., borough council, attention was called to the action of the Bell Telephone Company who is placing wires and erecting poles in the borough without an ordinance.

The Southwestern Telephone Company will spend $5,000 in improvements in Jonesboro, Ark., during the coming year.

Telephone Incorporations.

The Boone County Rural Telephone Company, Belvidere, Ill. Capital stock, $2,500. Incorporators: Fred W. Plane, D. W. Barningham and H. S. Hicks.

The Mears Ear 'Phone Company, New York City. Capital stock, $100,000. Directors- W. S. Mears, L. G. Laureau and Emmanuel Lewis, all of this city.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bellows Falls, Vt.—It is stated that the Bellows Falls Electric Light & Power Company proposes to furnish electric lights at Alstead, N. H., if they can get sufficient patronage.

Bloomfield, Ia.—Repairs amounting to about $1,200 are needed to the electric light boilers.

Boone, Ia.—The proposition for municipal ownership of the electric lighting plant here was lately defeated,

Brighton, Ala.—The city council will have a conference with the officials of the Birmingham Railway Light & Power Company relative to installing electric lights here.

Concordia, Kan.—R. S McCray has asked for a franchise for a gas and electric light plant, which he proposes to install in opposition to the electric light company now in existence here.

Dodgeville, Wis.—A movement has been started here to establish an electric lighting and ice-making plant.

Elkhart, Ind.—Conn's Electric Company will extend its electric lights to Goshen.

Granite, Ill.—This city wants a capitalist who will organize a company to establish an electric light and power system, to furnish municipal and commercial power and light. The city will use from 100 to 150 arc lamps, and there is said to be an opportunity for a considerable commercial business.

Hopkinsville, Ky.—The Hopkinsville Gas & Electric Light Company has been incorporated.

Keithsburg, Ill.—Tom A. Marshall, of this place, has sold the electric plant to the Haydens of Blairstown, Ia. They will make extensive improvements after taking possession.

Leonard, Tex.—The Electric Light & Ice Company of this place has increased its capital stock from $15,000, to $20,000.

Magnolia, Ark.—Preparations are being made for the immediate construction of an electric light plant here.

New Richmond, Wis.—This city's electric lighting plant was badly wrecked recently by the bursting of some machinery. One large dynamo was completely destroyed, two large belts and one pulley broken. It will take a month to make improvements.

Princeville, Ill.—The village board is considering the matter of putting in an electric light plant. Two gentlemen, representatives of the Fairbanks-Morse Company of Chicago, have submitted a proposition to the council in regard to installing a lighting plant.

Smithville, Mo.—The electric light plant here, owned by Harry Golden, was destroyed by fire, causing a loss of about $3,000.

St. Ignace, Mich.—The special election held here recently to bond the city in the sum of $15,000, for the installiation of an electric lighting plant, was carried. The lights will be put in at once. The city has been in darkness since fire destroyed the plant June 27.

St. Paul, Minn.—The St. Paul Gas & Electric Company has been directed to extend its electric service to Lexington.

Terre Haute, Ind.—The board of public arrangements has decided to advertise for bids for the lighting of the city with electricity.

Two Rivers, Wis.—William Rahr and associates have made application to the city of Manitowoc for a franchise for the operation of an electric light and power plant. Their application is likely to be granted.

Wilmington, Del.—A new electric light plant is to be installed in the County Insane Asylum.

STREET RAILWAYS.

Bloomington, Ill.—The Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company is trying to secure the right of way in Williams Township

Chester, Pa.—The Philadelphia & West Chester Traction Company has secured the right of way for its new line as far as Garrettford.

Edwardsville, Ill.—The city council has granted permission to the St. Louis, Springfield Electric Railway Company, for an extension and rights on certain streets of this city.

Eugene, Ore.—The Willamette Valley Electric Railway Company has been incorporated with a capital stock of $1,000,000. J. W. Wilson, W. J. Wildey and others are the directors. The purpose of the incorporators is to build electric roads from here into the farming districts contiguous to this city. Franchises will be asked for lines from Eugene to Cottage Grove on the south, Corvallis on the west, Blue River on the east and Salem on the north. This latter road is intended to connect with the electric line which it is said will connect Portland and Salem.

Forest Grove, Ore.—The citizens of this place and vicinity are much interested in the building of the electric line from Portland here. A meeting was held lately to raise the remaining $30,000 of the $100,000 which must be secured before the road will be started. The promoters expect to complete their work soon.

Kalamazoo, Mich.—It is said that work on the electric line that will run from this city to Grand Rapids will be started this month and that before snow flies interurban cars will be running from here as far north as Otsego.

Knoxville, Tenn.—The Knoxville Traction Company is to spend over $600,000 in improvements and extension in this city. This large expenditure is already in course of being made. The Traction Company has spent a vast sum of money in Knoxville, and this additional amount makes it one of the most beneficial corporations that Knoxville has in the way of giving numerous men employment.

Lewiston, Ida.—A meeting of the stockholders of the Waha Irrigating Land & Power Company was held lately, and the following directors were elected for the ensuing year. Harry L. Irwin, J. G. Trainer, Fred E. DuBois, Henry Heitfeld and L. A. Porter. Mr. Trainer stated that he would soon ask the city for an electric street railway franchise, which will be built as a necessary adjunct to the irrigation project.

Mankato, Minn.—The people of North Mankato are making an effort to raise $5,000 to secure the construction of an electric railway.

Marshfield, Mass.—The citizens here are discussing the proposed trolley line by the Plymouth County Railway Company.

Newark, N. J.—Agents for the Lehigh Valley Traction Company, a Pennsylvania concern, have obtained rights of way for the new electric road that will connect Morristown and this city, from more than 85 per cent. of the people living along the line as far as the Passaic River at Hanover. Applications have been made to all the different town committees for franchises. The company will find the most direct route to connect with some of the Public Service lines into Newark.

Portland, Me.—A continuous trolley ride from this city to New York is now only interrupted by a stretch of 19 miles from Kennebunk to York Beach, and these points will be connected next summer. The Atlantic Shore Line Railroad recently opened its line from Biddeford to Kennebunk, a piece 12 miles long. Portland is now connected by electric railways to Kennebunk and Boston to York Beach.

Richmond, Ind.—The organization of the company promoting the electric line between this city and Greenville is progressing. J. E. Cassatt, promoter of the line, has been along the right-of-way, and is meeting with much encouragement. As soon as the capital is interested in the line an organization will be perfected.

Terre Haute, Ind.—The Terre Haute Electric Company has commenced work on the survey of its line.

Viroqua, Wis.—The town of Coon by a very decisive majority voted by petition $10,000 in bonds for the construction of the La Crosse-Viroqua Electric Railway.

Williamsport, Md.—The Hagerstown Electric Railway Company will extend its line into Berkeley County, W. Va.

POWER PLANTS.

Winnipeg, Man.—This city is about to secure a great development of electric power to be transmitted here from the lower Winnipeg River, to the north, by wire. A company with a capital of $5,000,000 has been formed with both local and Eastern men at the head of it. The officers are A. J. McDonald, former premier of the province, president; Daniel McMillin, governor of Manitoba, vice president; and R. P. Roblin, the present premier, secretary and treasurer. This company states that it expects to have power into the city in two years and to deliver it to manufacturers at half the present cost of steam. About $100,000 has already been spent in development and engineering. The power will be transmitted 40 miles.

BIDS WANTED.

Alpena, Mich.—The sale of $250,000 Alpena waterworks and electric light bonds, made June 25, has been declared off, as the provisions of the resolution authorizing the sale were not complied with. The bonds will now be advertised, and sealed bids received up to 2 o'clock August 20, when they will be opened and contract awarded. The premium on the first sale was $10,000.

Washington, D. C.—Bids will be opened at the Treasury Department on August 23 for installing a complete system of electric lighting at the United States Courthouse and Postoffice Building at Trenton, N. J. Specifications can be obtained on application to the supervising architect.

NCTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12½@12¾c.; casting, 12⅜@12½c.

The Chicago and Milwaukee Electric Railroad Company for July shows an increase in earnings of $12,713.

The annual report of the United Traction Company of Albany, N. Y., shows net earnings of $588,343.

The stock of the Interborough Rapid Transit Company of this city took a sensational rise on the Curb market Monday going to 143½, a rise of 8½ points for the day.

The American Railways Company (Philadelphia) has declared the regular quarterly dividend of 1½ per cent., payable September 15 to holders of record August 26.

St. Louis Transit Company's gross earnings for July broke all previous records in the history of that company, being $984,644.20, as against $639,705 in July, 1903, an increase of $344,939.50, or nearly 50 per cent.

Walter C. Nelson, president of the Northern Traction Company of South Bend, Ind., has filed a mortgage of $3,500,000 to the Knickerbocker Trust Company of New York and Benjamin L. Allen, New York, co-trustees.

The property of the Oshkosh (Wis.) Electric Light & Power Company, which has been for the last eight months in the hands of a receiver, was sold on Friday at public auction for $215,000 to W. H. Whitney of Boston.

The gross earnings of the Cincinnati Traction Company for the first six months of this year were $1,775,387, of which the city receives 6 per cent. or $106,523, according to a report made to City Auditor Perkins by his experts.

Mayor Timanus of Baltimore has announced that he is having plans outlined for a municipal heating, lighting and power plant in the wharf district of Baltimore. Subway Engineer Phelps estimates the cost at about $150,000.

It is reported from Minneapolis that by the end of the calendar year Twin City Rapid Transit will sell between 115 and 120 and will be receiving 1½ per cent. quarterly. The company's current earnings are understood to indicate an earning power of about 10 per cent. on the common stock.

Earnings of the Interborough Rapid Transit Company of New York for the quarter ended June 31 have been made public. The gross receipts were $3,746,101, an increase of $474,314, and the operating expenses, $1,532,213, an increase of only $230,124, the net earnings being $2,213,888, an increase of $244,190.

The Lorain Steel Company has commenced suits in the United States Circuit Court for the New Jersey District against the Wireless Electric Railway Company of the District of Columbia and the Central Passenger Railway Company of New Jersey. It is alleged in the bills of complaint filed in these suits that these companies have infringed certain patents owned by the Lorain Steel Company relating to surface contact electric railways.

Speculation has been active the past week over Metropolitan Street Railway, Metropolitan Securities and Interborough Rapid Transit of New York. No disclosures have been made as to the basis for the sharp advances. It would be folly to credit the movement to pure manipulation. The character of the buying forbids the idea. It is believed there is going to be a rearrangement ultimately of the relations between the various traction interests of Manhattan and the Bronx.

ELEOTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Aug. 15
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	151½
Metropolitan Street Railway	123⅞
Metropolitan Securities	94¼
Ninth Avenue	195
Third Avenue	125
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	237
Brooklyn Rapid Transit	54½
Public Service Corporation (New Jersey)	98
Philadelphia.	
Consolidated Traction of New Jersey	67
Philadelphia Traction	98⅞
Union Traction	54
Boston.	
Boston Elevated	148⅜
Massachusetts Electric Companies, com	18
do. do. do. pref.	68
West End Street, com	91
do. do. do. pref.	111¼
Chicago.	
City Railway	168
North Chicago	71
Union Traction, com	4⅛
do. do. pref.	30
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	11⅛
do. pref.	50
Electric Boat, com	40
do. do. pref.	74
Electric Lead Reduction	¾
Electric Vehicle, com	9
do. do. pref.	14
Westinghouse, com	160
do. pref.	190
General Electric	165
Boston.	
Edison Electric Illuminating	251
General Electric	165½
Westinghouse Electric & Mfg., com	80
do. do. do. pref.	90
Chicago.	
Chicago Edison	145
National Carbon, com	35¼
do. do. pref.	107½
Philadelphia.	
Electric Company of America	9⅜
Electric Storage Battery, com	61
do. do. do. pref.	61
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	137½
Western Telephone Company	14½
New England Telephone Company	123¾
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	180
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	89
Miscellaneous.	
Chicago Telephone Company	120
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	30
Consolidated Car Heating	64
Standard Underground Cable	200

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EDITORIAL NOTES.

The Electric Railway Position in England. It is expected that by January 1, 1905, a considerable portion of the Metropolitan District Railway of London will be served with electric trains. That is the prediction of the chairman, Mr. R. W. Perks, but in many quarters it is considered that a liberal margin after that date may safely be allowed. The large power station at Chelsea is virtually completed, and its machinery is being installed, while the sub-stations are nearing completion. In regard to the rolling stock something of a fuss was made a short time ago in English newspapers, because many of the 420 cars for the 60 new trains were ordered from Continental builders. It is now explained that 280 out of the 420 were ordered on the Continent because the bids from English contractors were from 30 to 40 per cent. in excess of the foreign bidders. But, as the English firms subsequently came down in their prices, the remaining 140 cars were placed with them for execution. The companion undertaking, the Metropolitan Railway Company, is expecting the delivery of the first portion of the turbo-generating plant for its Neasden station at any moment, The cables and conductor rails have been laid, and the general equipment of the permanent way has been completed from Baker street to Uxbridge, and similar operations are now proceeding night by night on the Inner circle section. The rotary converting and transforming machinery has been installed in most of the sub-stations, and some 70 of the cars built in England have been delivered.

By the time the Metropolitan and District Companies are both ready to run electrically the London, Tilbury & Southend Railway, over whose lines some of the Metropolitan District trains run, will have part of its system converted ready to commence electrical working at the same moment. Operations to that end are now proceeding.

In regard to the English main line railways there is as yet little disposition to take serious steps forward in the direction of electrical working. The Great Eastern chairman announces that his directors are still contented to stand still and watch the experience of the Liverpool & Southport, and the North Eastern electrified sections.

Just now the Board of Trade has under consideration the question of protecting the third-rail of the electrical systems which are working at Liverpool and Newcastle, so as to insure the safety of employes and trespassers. The half-a-dozen fatalities from electric shock received on these two railways during the last six months, and the consequent agitation in Parliament has caused the inquiry. In some circles it is contended that it is mainly the trespasser, who has no right upon the track, that has been killed, there is little cause for action; but there is also agitation on behalf of the general body of railway employes, who are continually crossing the tracks, that everything in reason shall be done to safeguard them. It is impossible to anticipate at all what the Board of Trade is likely to stipulate when it has completed its consideration of the official reports which have been presented, but we note that Prof. J. A. Fleming of London is among those who hold that some more complete protection of the conductor rail is needed, his leanings being in the direction of a covering in the shape of an inverted L with corresponding alteration in the form of collecting device employed.

Electricity in Agricultural Districts. The farming element of the United States represents about one-half of its population. In order to successfully meet the competition in price and productiveness the farmer has taken a new tack. The old time-honored methods are being enlarged upon and the soil and its workers are slowly but surely imbibing the spirit which actuates the strenuous "city man" in his desperate efforts to emerge from the mediocrity of position and wealth and arise to the greater heights of business success and social standing.

The farmer has recognized in the use of electricity an aid to this end which he cannot afford to dispense with, and in consequence the larger and more business-like agricultural propositions represent a series of operations embracing the use of all that modern science and engineering can supply for facilitating the planting, care and reaping of the fruits of the earth.

The use of electricity for stimulating the growth of plants by passing it into the soil or in producing light at night and thereby hastening the harvest, are not of sufficient practical importance to need more than passing notice. But in relation to the use of electricity for the purpose of taking the place of manual labor by applying power, for supplying light at night over large areas to enable the harvesting processes to be readily and rapidly performed, and last, but not least, for putting the agriculturalist, by means of the telephone, in touch with the business or commercial centers of his vicinity or in fact of the United States.

These are the applications of electricity which count in the year's profits, and in this respect the telephone may well take the lead as shown by the following incident, which occurred in the great fruit-growing valley of Nova Scotia:

"A steamer of Halifax was to sail on Saturday afternoon for Liverpool. Her agent telephones to Kentville and Wolfville on Thursday that there is space left for say 2,000 barrels of apples. Kentville and Wolfville telephone to the sub-agents of the London (Eng.) fruit dealers, 'How many barrels can you send to Halifax?' These sub-agents jump into their gigs and in an hour have arranged with the orchardists as to the number of barrels to be delivered on Friday evening at each station along the railway. Then they telephone the result to head stations. Cars are provided in accordance. The fruit is shipped to Halifax Friday night, put on board the steamer the next morning and off goes the steamer, the fruit having been exposed to high temperature hardly at all, the orchardists having had ample time to get their barrels repacked, the railway full opportunity to supply the necessary cars and the steamer being able to take on board the freight without exposing it to the influence of adverse conditions of weather on the wharf."

The cost of power installations for farming service can be supplied by many manufacturers on application, and according to a recent estimate by a large telephone supply house, a one mile metallic telephone circuit in Illinois, including cost of poles, wire, insulators and labor, can be covered complete for the sum of $63.75.

If this is the case it seems that the farmer who neglects such modern conveniences, is willfully and woefully behind the times.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Advices from Switzerland state that last year in that country thirteen persons were killed by electricity. Of the thirteen fatalities, five occurred to persons employed in connection with the generation and distribution of electricity, one to a fitter of an electric firm and seven to persons not connected with the electrical industry. In the case of the five accidents to the members of the staff of electricity undertakings, it appears that the victims themselves were mostly to blame. All the fatalities were caused by alternating currents, the voltages of which were 130 in one case, 500 in another case and from 5,000 to 10,000 in nine cases. In two instances the exact pressure could not be ascertained.

A complete electric bulb plant in full operation is an attractive feature in the Palace of Electricity at the World's Fair. A force of 22 girls is employed and the daily output reaches 1,250 perfect globes.

Milk may be sterilized by electricity, according to M. E. Guarini. The ordinary process by heating appears to change the composition of the milk so as to detract from its nutritive qualities, but it is claimed that the new process does not involve this drawback. At first, a continuous current of 5 amperes was sent through a quart of milk, the applied voltage being 170. Milk at a certain distance from the electrodes was found to be perfectly sterilized, but it also become coagulated in the vicinity of the electrodes. Upon employing special electrodes, the coagulation was almost imperceptible. More perfect results were, however, obtained with alternating currents. With an alternating current of 110 volts and carbon electrodes, it was possible, it is said, to sterilize the milk without any coagulation effects, when the current density was properly adjusted and the frequency sufficiently high. It was found inadvisable to add any foreign substance to the milk for the purpose of increasing its conductivity. According to the *Electrician*, London, platinized carbon electrodes are the best.

Arrangements for the 22d annual convention of the New York State Street Railway Association, to be held in Utica Tuesday and Wednesday, Sept. 13 and 14, are progressing satisfactorily. The headquarters of the association will be at the Butterfield and all the business sessions will be held in the auditorium. The convention proper will open at 10 A. M. Tuesday and will continue until 4 o'clock Wednesday afternoon, when, it is expected, adjourment will be taken.

Wireless telegraphy is to be employed to aid in saving the forests of the West. Plans are being made in the Bureau of Forestry to establish wireless stations at intervals throughout the Rocky Mountains where there are large forests, and where fires occur in the dry season every year, destroying vast areas of magnificent timber. At these stations expert observers will be kept who will give warning whenever a fire begins, and help will be called to assist in extinguishing it. The first system to be set in operation will be in the Black Hills.

In a paper recently read in England before the Manchester Geological and Mining Society, comparing the direct current and polyphase systems as applied to collieries, the authors, Messrs. Philip C. Pope and Norman D. Cameron, stated that in deciding which system to adopt the relative advantages should be considered under three main heads—first, which would give the greatest freedom from breakdowns, and consequently the maximum economy in maintenance expenses; secondly, which would be most efficient in transmission, distribution, and transformation of energy; and, thirdly, which was cheapest to install, given equally good material and workmanship in each case. All these points were considered, and the conclusion was in favor of the three-phase alternating current system.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 89.*)

There are many kinds of wiring which must be done to fulfill the requirements of the specifications. These specifications cover the character of wiring and the number of outlets as well as the purpose for which they will be used.

The system of wiring to be employed is also specified and must be carefully planned out and observed in the subsequent work.

WIRING SYSTEMS.

Three-wire system, iron conduit, direct current.

Two-wire system, iron conduit, direct current.

Two-wire system, iron conduit, alternating current.

Two and three-wire system, iron conduit, for direct and alternating current.

The last system refers to a combination wiring plan, the wires protected in conduit, to be connected to either the three-wire system of the street service or a private two-wire plant in the building. A schedule can be prepared which will include the general method of wiring, the system of conduit work, the exact voltage to be supplied and the character of the current—whether direct or alternating.

System.	Schedule.	Volts.
Two-wire.	No. of mains.	110
	" feeders.	
	" risers.	
	" sub-mains.	
	" branches.	

A more elaborate schedule can be worked out comprising all the details of a wiring proposition, but for general practical purposes the above is sufficient.

According to an authority, from whose words the following definition and requirements are taken with reference to the purpose in view in using conduits "The object of a tube or conduit is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury, and as far as possible from moisture. Tubes or conduits are to be considered merely as race ways, and are not to be relied on for insulation between wire and wire, or between the wire and the ground." Conduits themselves must meet with certain requirements before they can be considered fit or safe to use.

Although many types can be selected, the conditions for their installation and for governing their selection may be better understood with reference to the following limitations:

GENERAL REQUIREMENTS FOR CONDUIT.

(I) The conduit between junction box and junction box must be continuous.

(II) It must be continuous between junction box and fixtures.

(III) It must be composed of such material or be of such construction that neither the insulation of the conductor or the insulation within the tube itself will be ultimately affected or deteriorated.

(IV) The conduit must be of such material that it will resist the effects of heat; it must not ignite or burn through the overheating or fusion of wires within it.

(V) It must be strong and hard enough to resist blows of hammers, the action of saws, or the points of nails or screws. It must, in fact, be able to resist mechanical injury due to these causes without collapse or fracture.

(VI) It must be capable of being installed as a complete pipe or conduit system without conductors so that all heavy work on the building can be completed before the wires are pulled through their respective tubes.

It might be added with reference to these facts that the risk of installing more than one wire in a tube is so great as to be, except where particularly specified, forbidden by the Fire Underwriters. Where specially approved steel or iron conduit is installed, permission to use twin conductors or two conductors in the conduit is a matter of discretion on the part of the authorities. When iron or steel armored conduit meets with the approval of the fire underwriters it must be able to meet such requirements as are embodied in the following:

REQUIREMENTS FOR IRON AND STEEL ARMORED CONDUIT.

(A) When the tube is grounded to one leg of the circuit and the wire to the other, the volatilization of all or part of the wire when it is "burnt out" must not injure the tube.

(B) The insulating protective coating inside the tube must not become soft at a lower temperature than 158 degrees F. (70 degrees C.).

When water is boiled inside the tube it must not dissolve the constituents of the insulation but must remain in its original condition.

(C) The effect of immersion or soaking in water for a few days must not so affect the mechanical integrity of the insulating material that it becomes weak and therefore useless.

(D) The insulation resistance of the tube must remain high, if the length of tube is bent and filled with water and a test made at the end of three days. The insulation resistance under these circumstances between the metallic pipe and its contents must not fall below 1 megohm.

In order to continue the remarks to be made in general about conduit, its requirements and its installation it may be further stated that all conduit ends projecting must be filled with an insulating compound to protect its contents from moisture and deterioration. This practice must be followed out at the junction boxes as well, and particular attention must be paid to all joints which according to requirement must be made moisture-proof and air-tight.

As regards the finishing of the ends of projecting conduits, these must extend at least 1 inch beyond the mortar or plaster because of the possibility of moisture and foreign matter otherwise entering the tube. If necessary, this projection may be subsequently cut down, but it must project at least ½ inch beyond the wall surface when said surface is finished. These requirements are entirely in line with the dictates of practice and reason and mean the avoidance of trouble, both with regard to the choice of conduit and its installation.

Laying Out a Conduit System.—In laying out the plans of a conduit system certain responsibilities rest with the architect as well as the consulting engineer or contractor. The demands made upon the contractor and consulting engineer relate to the mapping out of the work and its subsequent installation. That of the architect relates to the provisions made in the construction for the reception of the conduits in a convenient and practical manner. The architect's duties consist, therefore, in making provision when preparing the plans of the building, for such ducts, pockets and channels as may be required for the conduits and the electric light and power lines they carry.

Insulation of Conductors.—The great danger of grounds and short-circuits in buildings may be reduced to a minimum if the general principle is followed out when installing wires of regarding their installation, however good, as non-existant. If wires are installed in buildings, whether in conduit, moulding or on insulators as if they possessed no insulation, but were bare, then the precautions taken would be so far reaching that the risk of

faults from grounds or poor insulation is negligible.

Mechanical Work.—Too much stress cannot be laid upon the necessity for as perfect mechanical work as can be done. The details of soldering and connecting wires, the taping of wires and the proper method of securing the conduit—all of these belong to the field of purely practical work calling for experience and skill on the part of the employes. Efficiency can only be secured if every portion of the conduit and conductor undergoes a careful inspection during the development of the work and during its completion. The best point from which to start, whether the wiring or conduit is being installed, is the center of distribution. After one or many have been selected, by a careful examination of the conditions, then it is necessary to select the correct points at which the switches and cut-outs controlling the different circuits are to be placed. In order to render such positions accessible for ready handling in case of short-circuit, grounds, breaks or other faults, panel boards are generally employed. These boards are miniature switchboards at which all the circuits of a part of a floor, or of one or two floors, converge. They are the sub-centers of distribution of a large building.

Insulating Materials.—Perhaps one of the greatest problems in electric wiring has been the selection of the correct insulating materials for electrical work. In order that an insulating material may meet with the proper consideration before trial it is necessary that it should be

1. An insulator.
2. Non-combustible.
3. Non-absorbent.
4. Non-hygroscopic.

There are many insulators and insulating materials now in use which are apparently immune from shortcomings in this respect, but a close examination will reveal the fallacy which a rigid test would make certain. In the wiring world insulating material is used for switchboards, insulators, and insulation of the following materials: Marble, slate, porcelain, glass, mica.

The marble and slate are used for switches, panel boards and switchboards. The marble is entirely used for switchboards. The mica is employed for the covering of cut-outs and in a compressed form for sockets, etc. The porcelain and glass are employed for general insulating purposes. The covering of wires differs from this, in that it consists of rubber or gutta-percha, but the strict requirements for insulation whether of wire, switches, switchboard or other devices are not any too high where special work is to be done.

Special Insulation.—In damp places, where moisture is constantly soaking into all materials, such as dye houses, breweries, stables, pulp mills, laundries and acid manufactories, where fumes are exercising a deleterious effect, special insulation is required on wires, which is described thoroughly in the following paragraph:

The wire must have a solid insulating covering of at least $\frac{3}{64}$ of an inch in thickness, and this covered with a strong and tightly fitting braid. It must be difficult to burn or ignite and must possess insulating power sufficient to show 1 megohm after exposure through submersion to the action of water for two weeks, at a temperature of 70 degrees F., or after three days' exposure through submersion to the action of lime water and the passage of a current of 550 volts pressure for three minutes. It is necessary in addition to expose such wire to the direct action of those liquids or fumes to which it will be subjected.

Concealed and Exposed Work.—Wiring that is either concealed or exposed represents the two cases where the allowance of current for the wires is different for the same amount of lighting. By this is meant that a wire of a given number of circular mils cannot carry as much current for concealed work as for open or exposed work.

In exposed work the air freely circulates around the wire and its radiating power is not limited by being surrounded by conduit or moulding. Such radiation as generally occurs takes place through the insulation into the outer air:

Concealed wires in conduit.		Open work on insulators.	
Gauge No. B. & S.	Amperes allowable.	Gauge No. B. & S.	Amperes allowable.
0000	218	0000	312
000	181	000	262
00	150	00	220
0	125	0	185
1	105	1	156
2	88	2	131
3	75	3	110
4	63	4	92
5	53	5	77
6	45	6	65
8	33	8	46
10	25	10	32
12	17	12	23
14	12	14	16

The relation of current to insulation resistance has also been established by law as regards insurance. The insulation resistance of the mains, feeder branches, etc., must not fall below a certain figure of at least 100,000 ohms. The entire wiring installation must not represent less than the insulation resistance given in the following table:

Amperes.	Insulation resistance.
10	4,000,000
25	1,600,000
50	800,000
100	400,000
200	200,000
400	100,000
800	50,000
1,600	25,000

The manner of development of the table is quite evident after a slight examination of the relationship of the figures to each other. The basis is 4 megohms for 10 amperes, which would mean a corresponding sub-division of the resistance for any other greater current. For 20 amperes the insulation resistance is one-half, for 50 amperes one-fifth, etc., as indicated.

Many detailed requirements have been established by practice relating to the essential elements of a wiring equipment. They relate to such important articles as switches, cut-outs, fixtures, etc. As regards the last, particular attention must be paid to the question of insulation resistance, where the fixtures supply gas as well as electricity. In this case the fixture is insulated from the gas pipes or ground connection by means of an insulating joint. The requirements read as follows: "Insulating joints to be approved must be entirely made of material that will resist the action of illuminating gases, and will not give way or soften under the heat of an ordinary gas flame. They shall be so arranged that a deposit of moisture will not destroy the insulating effect, and shall have an insulating resistance of 250,000 ohms between the gas pipe attachments, and be sufficiently strong to resist the strain they will be liable to in attachment."

Perhaps the most fruitful cause of grounds and short-circuits may be found in fixtures and socket unless the utmost care is taken during their installation to remove such possibilities by strict adherance to the observed code.

Grounded Wires.—When it becomes necessary to ground wires, when lightning arresters are installed or protective devices are employed for telegraph, telephone, fire, district messenger, and burglar alarms or their equipment, the ground wire must be connected to a gas or water pipe and connection made beyond the first joint by soldering. If such a ground connection is impossible a ground must be made by means of a metallic plate or a collection of loose wires or pipes buried in moist earth. The

ground wire in this case must not be smaller than a No. 16 B. & S. and must be supported as though it were a high potential wire to the final earth connection. The protective device is of an electromagnetic character and saves the circuits to which it is connected from a sudden rise of current and pressure due to the crossing of signaling and message-conveying wires with power or electric light circuits. It is inclosed in a waterproof metallic case and is placed outside the building, or if placed inside, the wire leading into it through the wall must be carefully protected by approved insulating bushing. A very useful solution for soldering wires may be made up from the following formula. It is recommended that after use the joint be carefully wiped to remove all traces of the acid and thereby prevent subsequent corrosion:

Solution of zinc saturated....5 parts.
Glycerine........................1 part.
Alcohol. ....4 parts.

The solution of zinc is obtained by taking a 6 oz. bottle and half filling it with hydrochloric acid. Then slowly drop in pieces of granulated zinc until the ebullition ceases. The solution then obtained corresponds to the first item of the formula just given. The joint is first heated with a blow-pipe or soldering iron after being carefully cleaned to expose the bright metal and the solution is applied with a stick and the solder will immediately flow freely.

A very good plan is to follow a certain system as regards the position of every light in the building. Such a plan may be embodied in the form of what could be called "A Distribution Sheet" on the following order:

Distribution Sheet.

Cutouts.	Floor.	No. of Lights—1. Ceiling.	Wall.	Switches.	No. of Lights—2. Ceiling.	Wall.	Switches.	No. of Lights—3. Ceiling.	Wall.	Switches.	Total Lamps.
2	1	0	1	1	2	0	1	0	3	0	6
1	2	1	0	0	0	2	0	3	0	1	6
	3										
	4										
	5										
	6										
	7										

The idea of this sheet is to conveniently locate the position of all lights for ready reference and to hold the plan of the wiring in as explicit and condensed a form as possible. The importance of this cannot be overestimated when the wiring of a 20-story building is considered with its numerous outlets. In order to facilitate the work an outlet sheet is convenient to use. It is of a much simpler character than the above and may be laid out in this form:

Floor	Outlets.	Purpose.
1	10	Lighting.
2	8	"
3	6	"
4	7	"
5	5	"
6	9	"
7	2	Motors.
8	3	Lighting.
9	6	"
10	4	"

In laying out the position of the conduit, the exact knowledge of the position of each outlet and junction box is a matter of great importance. Mistakes in the wiring plan in this respect on a big job may mean considerable delay, confusion and expense. Both these sheets may be extended to cover any number of floors, and from them estimates can be prepared for future work as regards labor and material.

It is often the custom to estimate on conduit jobs, whether open or concealed, as well as moulding and insulator work, at so much per outlet, or so much per lamp completely equipped. In any case a list of the material required must be prepared and the cost of labor, to form a clear conception of the absolute cost. The items to be included in this list are based upon the character of the work, whether insulator, cleat, moulding or conduit. In each case various essentials are different, particularly when concealed work is done. In this case the estimate must cover the additional cost of labor involved in ripping up floors, grooving the walls and cutting out a place in the walls for panel boards. The routine work of a wiring problem is plain sailing, but the difficulties and unexpected expenses arise when special positions are required for lights and switches.

MODERN EUROPEAN ELECTRIC TRAIN LIGHTING SYSTEMS.

BY FRANK C. PERKINS.

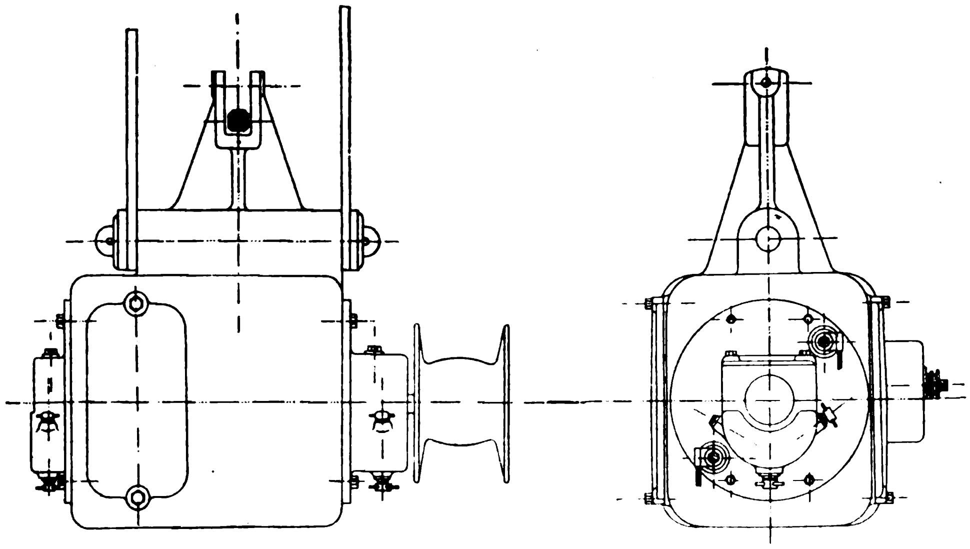
In America as well as in Europe the lighting of steam railway trains by electricity is becoming more popular every day, and a number of systems are in use at the present time which successfully solve this problem and give good satisfaction. On account of the excellent lighting facilities on high speed, high power electric railways as well as on the elevated and underground lines using electric power, the steam railways have found it necessary to improve their lighting systems, introducing electric lights on their first-class trains to meet the demands for better lighting by the public.

In America, the Gould, Consolidated and several other systems have been employed for several years past, while in Europe the Vicarino system has been extensively introduced by the Compagnie Generale Electrique of Nancy, France; the Kull system has been utilized by the Swiss engineers, Brown, Boveri & Co., of Baden, and the Dick system of electric lighting of trains has been introduced by the Osterreichische Siemens-Schuckert-Werke of Vienna, Austria. The accompanying illustrations and drawings give an excellent idea of the dynamo machines and other apparatus utilized and the method of operating the same.

Among the other important European systems which should not be omitted may be mentioned the Stone, Moskowitz, Jaquin, Bohmand Auvert, which have been successfully employed for a number of years. Nearly all of these electric train lighting systems, including the last mentioned, utilize a storage battery in connection with a shunt-wound direct current dynamo. The Jaquin system utilizes two sets of accumulators, one being charged by the dynamo while the other is being used for lighting purposes. The power for driving the dynamos is obtained from the car axles in many of the systems although separate steam engines have also been utilized on American as well as European lines, the steam being taken from the locomotive. The Kull system utilizes the power of the car axle, the dynamo being driven by belting at a speed of about 650 revolutions per minute. With this system, as in a number of others, when the speed of the dynamo falls below a predetermined amount the necessary switches are opened and are

again closed when the speed of the train has again increased sufficiently.

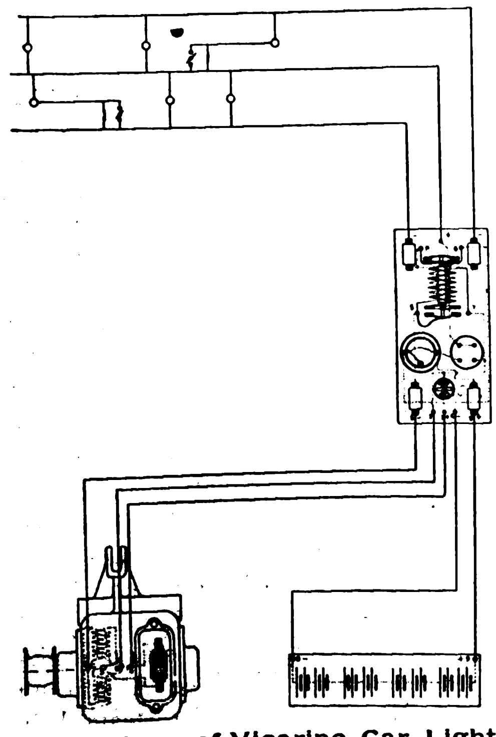
With the Stone system, as soon as the train has reached a speed of 25 kilometers



Vicarino Dynamo of 100 Kilograms for Electric Car Lighting.

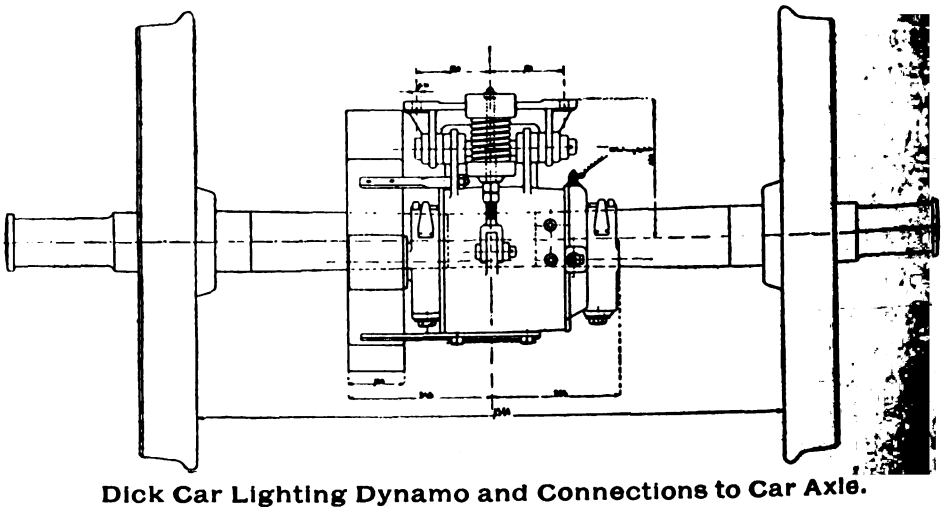
per hour the dynamo begins to charge the storage batteries, belt transmission being utilized for employing the necessary power from the axle. The generator is hung from beneath the car in such a manner that it gives a tight belt at slow speeds, with a certain amount of slipping during high speeds, thereby giving the regulation required.

The illustrations and drawings show the arrangement and construction of the



Connections of Vicarino Car Lighting Apparatus—Controller, Dynamo, Battery and Lamps.

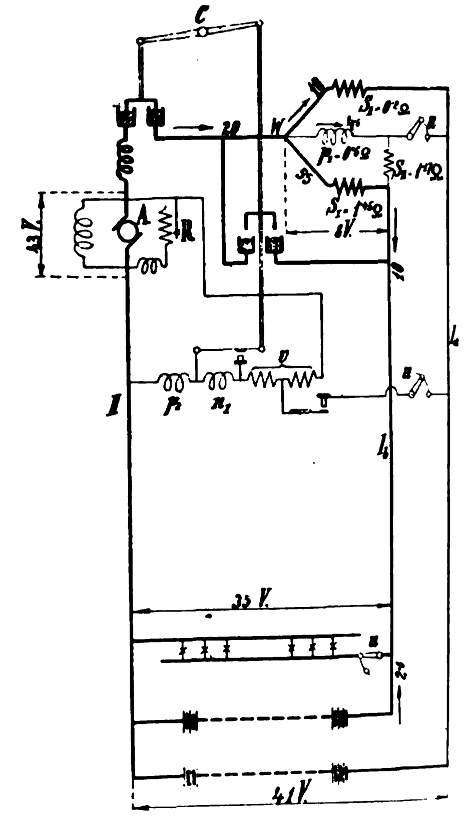
dynamo, battery, switchboard and regulating apparatus employed with the French system of C. Vicarino of the Compagnie Generale Electrique, Nancy. It may be stated without question that the number of incandescent lamps and the candle power of the same as employed on the European railway trains does not compare with those utilized on American cars. Many of the lamps installed give but 5 to 6 cp., and others from 8 to 10 cp., while 16 cp. and 32 cp. lamps are seldom employed. The voltage used on the Vicarino system is quite low, only 16 cells of storage battery being utilized. From 6.6 to 15 amperes are utilized for the incandescent lamps, the pressure being 32 volts. The storage batteries have a capacity of from 60 to 120 ampere hours, supplying the necessary current for from six to nine hours. The



Dick Car Lighting Dynamo and Connections to Car Axle.

express trains operate at from 60 to 85 kilometers per hour and the slow speed trains from 40 to 50 kilometers per hour. For charging the storage batteries the dynamo attains a speed of 250 revolutions per minute with the train moving at the rate of 50 kilometers per hour. The voltage at the lamps is maintained practically constant, regardless of the speed of the train by the automatic regulating apparatus employed. The dynamo which hangs below the car weighs 190 kilograms.

The details of construction and the method of handling the dynamos with the Dick system installed by the Oesterreichische-Siemens-Schuckert-Werke is indicated in the drawings shown. With



Connections of Dick Car Lighting System.

this arrangement the dynamo is supplying current to the lamps of the lighting circuit at all times when the train is operating at a speed of not less than 25 kilometers per hour. The maximum capacity is 25 amperes at 45 volts with a speed of from 700 to 2,400 revolutions per minute. The dynamo has four poles, the armature core being provided with slots and a series drum winding. The current is collected from the commutator by four carbon brushes placed at 90 degrees. The dynamo including the hangers and friction pulley weighs 200 kilograms. The cabinet containing the regulating apparatus is connected between the dynamo and storage batteries and the lamp circuits as shown in the drawing. It weighs

34 kilograms and measures 800 mm. high, 184 mm. deep and 550 mm. wide. The storage battery used with this system has 18 elements and has a sufficient capacity to carry the entire load of the lamps for five hours without the operation of the dynamo at any time during that period.

There has been a wonderful development within the last decade of electric systems for lighting railroad trains, and there is every reason to believe that in the near future a large proportion of the steam railway lines will adopt electric lighting on their regular accommodation trains as well as on their high speed and speed express trains. It would seem advisable, however, in working out these systems of electric train lighting to keep the fact in mind that in the near future electric power will be utilized to a great extent on branch lines of the steam railroads and in and about large cities, and the voltages used and system of lamp wiring for the coaches, it would seem, should be so arranged that by the simple throwing of a switch, the same lamps and lighting system could be operated from the railway power circuit when found necessary or possible, By this arrangement electric power from the generating station could be utilized whenever possible, while the coaches whether used as trailers or forming a part of regular steam railway trains could fall back on the car axle dynamo, train lighting system when having no other source of current.

THE STORAGE BATTERY AS APPLIED TO ELECTRIC RAILWAYS.*

BY W. E. WINSHIP.

Within the last few years there has been a decided change in the attitude generally taken as to the advantages and advisability of storage-battery installations. This is partly due to a better knowledge of the life which may reasonably be expected, and, to a minor extent, to improvements in construction and plates.

Storage batteries have shown their utility and economy especially in railway work, where current fluctuations are usually extreme.

Where the system, supplied from a single station, is large, and relatively small cars are operated, the instantaneous fluctuations will be a small percentage of the total load, and there would be no economy gained in removing them. The load in this case will very nearly follow the service supplied, i. e., be steady and proportional to the number of cars, and the only effectual use of a storage-battery plant, outside the large element of reliability of operation secured by it, would be in regulating the load-factor on the generating units in service. There would probably be, even in this case, a considerable economy resulting in operating the generating units and boilers at their most efficient load. This fact and their importance as a reliability factor might determine their installation under the above conditions.

When large cars are operated, perhaps even in trains, and high accelerations are demanded, as in interurban work, the conditions are entirely different. The fluctuations are then enormous, frequently much in excess of 100 per cent. over the average load, and we very often find stations operating on a 50 per cent. load-factor in order that the maximum demand may be within the overload capacity of the generators.

As is well known, the efficiency of a steam engine is greatly reduced, and that of a generator also, to a smaller extent, when the average is much less than their rated load. With steam turbines this is true to a somewhat less degree, but there is still a great variation of steam consumption. The net efficiency of the engine-generator combination is the product of the efficiencies of the two, and suffers, therefore, more greatly than either singly. By using a storage battery, either with or without a booster, to absorb these fluctuations, it becomes possible to raise the load-factor by shutting down one or more engines and boilers, with a consequent decrease in coal consumption, reducing also such items as labor, oil, waste and repairs, thereby effecting a great economy. It is possible then to operate with less apparatus, and usually some saving may be made in initial power-house outlay, since an equivalent battery plant would cost somewhat less than the engines, boilers and generators it displaces.

As with all machines and contrivances, the efficiency of a storage battery plant is not perfect. On certain classes of work (viz., short cycles of charge and discharge) it is remarkably high. If the fluctuations are within the hour-rate of discharge of the battery, and are of short duration, it is very nearly 90 per cent. Tests published by Highfield, covering a year's actual operation of a battery plant on such work, showed a net watt-hour efficiency of 84 per cent.

On complete charge and discharge cycles, it is decidedly less, 87 per cent. with the ordinary stationary types of batteries being about as high as can be obtained, while under practical operating conditions it is less than this, running from 70 per cent. to 80 per cent. according to the class of work the battery is called on to do. In spite of this fairly low efficiency the use of such a "peak" battery may result in a very considerable saving. Most especially is this true when the source of supply is a water-power of limited capacity, and, as already pointed out, as an emergency, it is invaluable.

The capacity of a storage battery is given in ampere hours, and varies with the rate of discharge. Taking the capacity as 100 per cent. at the 8-hour rate, the capacities at the 5, 3 and 1-hour rates are 87½ per cent., 75 per cent. and 50 per cent. respectively. The capacity of a storage battery is arbitrary to a certain extent; that is, a battery could be discharged for a longer time than would correspond to these figures. If, however, the discharge is continued beyond these values, the voltage drops too rapidly for good efficiency. It should be noticed that by saying the capacity at the 1-hour rate is 50 per cent. of that at the 8-hour rate, we do not imply that twice as many ampere hours must be put in as are taken out, but this is not the case. The ampere hour efficiency of storage batteries is very good, being 95 per cent. to 98 per cent.

To take care of the fluctuations on a power or sub-station, there are several ways of operating storage batteries. Necessarily, the voltage of a battery rises on charge and falls on discharge. If the generators have a falling characteristic, that is, the voltage drops with increasing load, and the maximum permissible drop is considerable, say 5 per cent. to 10 per cent., then a battery may be simply "floated" across the bus-bars, and will charge when the external load is light and discharge when it is heavy. The extent of the load equalization under these circumstances will depend on the sharpness of decrease in voltage, and the duration and magnitude of the fluctuations with reference to the size of the battery. Roughly, it may be stated that with a 5 per cent. to 7 per cent. variation of voltage above and below the normal and with current variations equal to the 1-hour rating of the battery, lasting for several seconds, the generator load variation will be constant to within 5 per cent. It is possible to adjust the combination of battery and generators for different load factors in either of two ways—first by cutting in or out a certain number of cells or by raising or lowering the average voltage of the station.

In many instances, however, it is essential that the voltage be maintained fairly

*From the "Journal" of the Franklin Institute, August, 1904.

uniform. Under these circumstances, in order to have the battery charge and discharge, the difference in voltage between the battery and the system must be made up automatically in some way. It is usual to employ a differential booster for this purpose. A brief description of such boosters may not be out of place. There are two booster systems which have come into general use in America, both of which are usually motor-driven.

In the one form the booster generator field consists of a shunt winding, to which is opposed a series winding, a portion of this latter carrying the generator load, while through the remainder is passed the external load. The shunt winding is so determined that with no external load the voltage of the booster generator will be equal to the maximum difference of voltage between the battery and generators. The series winding is so determined that with both generator and external load equal to the average, the resultant field and consequently the booster voltage is zero. One of the objections to this arrangement is that the resultant field is small in comparison with either component, and in consequence there is a serious amount of energy dissipated in the field magnets. The field energy has practically the same value independent of the battery load, so that the amount of this loss is of considerable magnitude. The self-induction of these abnormally heavy windings is very great and the pole legs of the field magnets necessarily long to accommodate them; these two facts condition a relatively slow response of the booster to variation of the load.

In the second form, the booster-field regulation is obtained through the use of a small auxiliary generator, whose field carries the generator load. This machine is so determined that with the generator load at its normal value the voltage is equal to that of the system. The booster-field circuit includes the armature of this auxiliary machine and is connected across the generator bus-bars. The result is that, with the average current in the auxiliary machine field, the voltage impressed on the booster field, and consequently the booster voltage, is zero. If the generator load increases by a small amount, the voltage of the auxiliary machine increases by a corresponding amount, and there is a resultant voltage impressed on the booster field, thus causing the booster to assist the battery to discharge. This machine may be so calculated that the generator load may be kept constant to within any predetermined limit. It has the advantage that there is no energy in the booster field when it is not required, and also that the regulation is dependent on the load which is to be regulated.

The length of the booster field magnetic circuit is normal, and the field windings are composed of a relatively small number of turns (for a booster on railway work usually wound for 50 volts maximum); as a result, the response of booster is almost instantaneous.

The determination of the size of a battery installation will depend on two elements: the maximum discharge rate which it is required to deliver, and the required storage capacity. When a battery is simply to act as a load equalizer, independently of its storage capacity pure and simple, then it is obvious that the battery should be chosen on the score of cost as small as is consistent with efficiency and life. For this purpose that type of battery which is calculated to withstand a maximum discharge rate with the least amount of deterioration and least drop in voltage should be chosen. These properties attach to plates having a great surface exposed to the electrolyte in the cells.

The combination of equalization of both instantaneous fluctuations and peaks of the average load is especially useful with water powers of limited capacity, as it is possible then to obtain the maximum output capacity of the plant. Another very prominent advantage, especially in operating on comparatively low heads, is that the difficulties of governing are largely obviated. This is of extreme importance in alternating current installations.

An example of such an installation, at Easton, Pa., may be quoted. The power plant consists of two 2-phase alternators, driven by water-wheels, located in a station about 2½ miles distant from the main power-house. In this latter are steam-driven auxiliaries. A mixed railway and light service is furnished. Before the installation of this battery an 800 hp. steam unit was in constant use to reinforce two A. C. motor generator sets, driven from the water-power, in order to care for the instantaneous peaks of the railway load. Since the installation of the battery, the water-power carries both the railway and lighting load. During the day the battery equalizes the railway load, receiving also a slight change; when the lighting load comes on, the battery furnishes a net discharge to cover the difference between the water-power capacity and the total load on the plant. From 12 to 4 A.M., when the load is extremely light, the battery is re-charged. They are able then to carry their load under normal conditions without the use of steam, excepting for certain auxiliary service, and are able to shut down an 800 hp. unit, and in addition to this advantage, by the removal of the railway load fluctuations, their lighting service is extremely satisfactory.

The preceding has reference to installations in central or sub-stations. Under certain conditions, it is advantageous to install batteries at points distant from generating stations. Such installations are of two types—"floating," or fed from a boosted feeder, and are termed line batteries. In electric railway work such batteries would be located at some distance from the generating station to maintain the line voltage.

In the case of a battery at the end of a boosted feeder, it is usual to trannsmit the average current, allowing the battery to absorb or give up the difference between the instantaneous and average currents. Such an installation may have a very fair efficiency, and will show a decided advantage over a high-tension transmission and sub-station scheme if the frequency of the car service does not justify the first cost and attendance required by the latter. The instances where these conditions hold are extremely numerous in interurban work. In many cases, however, a battery simply placed across the line will serve every purpose of the above, and will show several advantages over it.

(*To be continued.*)

CLOSING PIECES.*

The last piece of pipe which is put into position in a range of pipework is usually called a closing piece. For want of a distinctive name to denote the type of problem presented by the junction of one piece of work with another, the above title has here been chosen to represent the last piece of work which must be performed to join any two separately undertaken manufactures. The absence of exact definition of such "closing pieces" of work in a specification is the cause of many of the muddles which occur in contracts carried out jointly by two or more firms.

A flagrant case in point came under our notice recently. A large three-throw pump was to be electrically-driven, spur-gearing being introduced to give the necessary speed reduction. The motor specification provided that the motor spindle should be extended beyond the bearing, and be provided with a keyway for a rawhide pinion, while the pump specification asked for an exactly similar

*From the "Electrical Review," London

provision for the gear wheel. The necessity for providing the reducing gear had not obtruded itself on the notice of the writer of the specification. The mistake was only discovered on receipt of an inquiry by the electrical firm as to which end of the motor shaft was to be extended; a considerable amount of internal friction in the buying firm was the consequence. Although it is often trusted that such awful examples are rare, the delimitation of contracts presents many pitfalls to ensare the unwary. For example, an engine and dynamo, erected by separate firms, are to be painted. Who is to do it—the engine builder, the dynamo maker, or the buyer? Who is to choose the color, and who is to settle the amount of finish necessary? Unless the specification lays down the law, irritation may arise over points not essential to the good working of the plant.

An electrical contractor is fortunate enough to secure the order for generators and switchboard for a power station. Does he, or the buyer, provide the connections between the machines and the board? And—a point more likely to be overlooked—who is to connect the outdoor cables to the board?

In the actual carrying out of junction work, some judgment must often be exercised. It is too often the case that studs fitted "to drawing" by one contractor do not entirely coincide with the position of the stud-holes, also drilled "to drawing" by another firm, when the two pieces of work are brought together. Difficulties of this sort are usually overcome by means of a template sent by one contracting firm to the other by mutual arrangement. In some cases, however, it is found better to send one part fitted, the other with its flanges undrilled, the necessary junction work being done *in situ*.

The aim of the buying firm should be, of course, to throw the onus of possible mistake on the contractors. For this reason it is often advisable to give the whole of a contract to one firm, even at a slightly increased figure to cover middleman's profit, allowing that firm to give sub-contracts, doing all possible fitting before coming on site. The absence of confusion, and the freedom from encumbered ground space and superfluity of workmen during erection, will in many cases compensate the buyer for the extra money spent.

In cases where slight dimensional inaccuracies are shown by experience to arise almost inevitably, except at the cost of precaution so excessive as to be too costly, "give-and-take" provisions should be made. For example, when ordering pipework to connect separate pieces of plant such as engine and boiler, while the drawing should show such dimensioned lengths of pipe-section as to insure easy handling on delivery, the draughtsman should omit length-dimensions from the closing-pieces, marking them "to template." If this is done, the pipework is erected as far as the closing-piece, and a wood template is made showing the relation of flanges and position of bolt-holes. This, on being sent to the pipe-founders, enables them to supply a template-piece which goes into place without the chipping of flanges and filing of bolt-holes that is sometimes resorted to.

A very interesting example showing the variety of considerations necessary in defining the limits of a contract is that of a large steam-driven alternator. Usually one or more of the engine bearings also carries the alternator shaft, and the engine fly-wheel is utilized to support the field-poles of the alternator. The points to be arranged between the two firms are, who is to provide the shaft, coupling, rotor fly-wheel and outer bearing (if any) for the alternator, and what dimensions of the fly-wheel are necessary to provide the correct peripheral speed for the field-poles, and to reduce the angular variation of phase of the alternator (due to variation of turning moment of the engine) to reasonable limits? The last point must be fixed by the alternator builders from a knowledge of the impedance of their alternator windings and amount of cross-surge permissible. The other points are matters of arrangement. In one such case, the engine builders designed one end bearing to take its proportion of the alternator weight, and provided a half-coupling on their shaft and a separate outer bearing for the alternator. A firm of Bessemer steel makers delivered the alternator shaft on site, turned and fitted, the engine builders afterwards scraping their bearings to make a final adjustment on this shaft, and the dynamo builders provided the fly-wheel, fixing it on the shaft. Without absolute accuracy on the part of three firms, this course would have been impossible.

Other instances could be enumerated of the way in which contracts must be carefully defined to avoid either a gap or an overlap of work at the junction points of engineering undertakings, but sufficient attention has now been drawn to an important class of problems—the best method of combining the work of separate contractors.

The Aurora, Elgin & Chicago Electric line, has decided on an innovation among electric lines in establishing a dining car service as an experiment.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

AN INGENIOUS ARRANGEMENT OF AVAILABLE GENERATORS TO HELP OUT OF A DIFFICULTY.

We had occasion last summer to exercise our ingenuity in order to take care of an unexpected load at one of the beaches (Bergen Beach) in the neighborhood of Brooklyn, which may be of interest.

We had supplied Bergen Beach previously from our 2,400-volt, 60-cycle, two-phase system, but during the summer immediately preceding that of 1903 the Beach did not open at all, and the question of opening again last year did not come up until the last moment.

We did not have sufficient capacity on our two-phase system, and a 400 kw. two-phase motor-generator on order was not due until the middle of summer. We had, however, the following apparatus that was not in use: Two 250 kw., 500-volt, 25-cycle rotary converters, three 150 kw., 25-cycle, 6,000-volt transformers for same, and one 180 kw., 66-cycle, 2,400-volt, two-phase Stanley alternator, speed 666 r.p.m. We belted the Stanley alternator to one of the rotaries by substituting a pulley for the starting induction motor on the rotary. The set was started by a 10 hp., 230-volt, direct current motor belted to a second pulley on the alternator and operated from the 230-volt Edison direct current system.

Owing to the fact that the alternator was intended to be driven by two belts, one on either end of the shaft, we were unable to carry more than 150 kw. on the single belt. The load at Bergen Beach increased rapidly and soon got beyond the capacity of the single machine. We therefore obtained a 150 kw., 66-cycle, 2,400-volt Stanley alternator, speed 1,000 r.p.m., and belted it to the second 250-kw., 500-volt rotary. By running the second rotary as a direct current motor from the first rotary we were able to operate the two alternators successfully in multiple and to divide the load as desired by adjusting the field strength of the second rotary.

The method of starting was as follows: Start the first set by means of a 10 hp., 230-volt, direct-current motor from the Edison system and synchronize on the

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston Mass., May 24-27, 1904.

alternating current end of the rotary with our 6,000-volt, 25-cycle, three-phase system. The second set was started in the same manner and also synchronized on the alternating current end of the rotary. Then the 500-volt, direct-current circuit was made between the two rotaries and the alternating-current switch of one opened, leaving it running as a direct-current motor, after which the two alternators were synchronized with ease. The maximum load carried in this manner was about 225 kw.

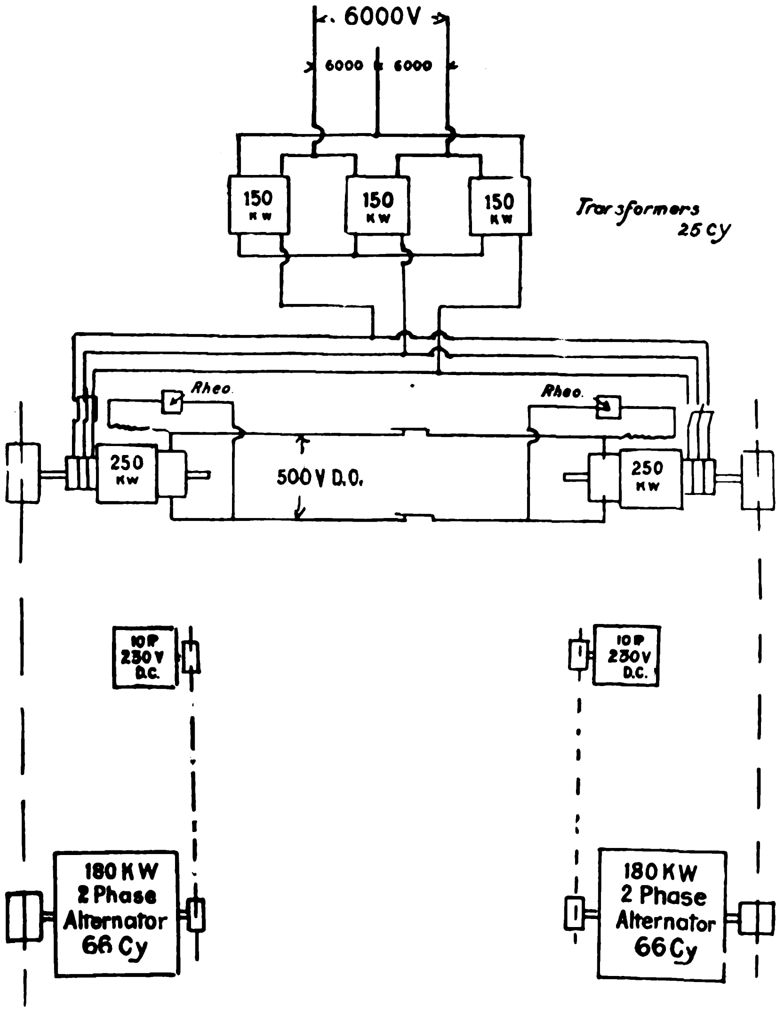


DIAGRAM OF THE CONNECTIONS

It was also possible to run the alternators in multiple with both rotaries running as synchronous motors, but this was not so satisfactory, as the division of the load could only by adjusted by the slip of the belts.

Herewith may be seen a diagram of the connections.

CABOT STEPHENS, Brooklyn, N. Y.

—

A TROUBLE PREVENTER.

In answer to yours of January 25, 1904, beg to advise that our memory for wrinkles is limited, but we had a rather peculiar case this winter which may be of interest.

We furnish power to two grain mills, and, as you probably know, they are very cold places in winter, and we had considerable trouble in getting them started on cold mornings, as they were continually blowing fuses in trying to get their machinery in operation. After the machinery was up to speed they had no trouble. The last time we sent a man there to help them out he left a set of fuses in their office on a shelf just back of the stove, and the next morning they had the same trouble, so put in the warm fuses, and everything started all right. They now take the fuses out at night and keep them in the office and they have no trouble whatever.

RALPH D. SMITH, Hoosick Falls, N. Y.

—

METHOD OF CONNECTING THOMSON RECORDING WATTMETERS ON A THREE-WIRE EDISON SYSTEM.

Number One—Showing a 110-volt meter carrying 110-volt incandescent lamps and a 220-volt motor so connected that the meter records the energy required for the lamps and the energy required for the motor at half potential or half value, thereby giving the customer a lighting and power rate with a ratio of 2 to 1, or to, say, a 15-cent rate for incandescent lamps and 7½-cent rate on the motor.

Number Two—Shows a 220-volt meter connected for power where a customer desired a few incandescent lamps. In this case the meter records the energy required by the motor and doubtless the kilowatt reading on the lamps, which makes it appear that the lamp and motor current is being sold at a motor rate but in reality a double motor rate is being charged for the current used by the lamps. This being the reverse of No. 1, the current in amperes is being recorded in the meter at 220 volts while in reality the lamps are being furnished with 110 volts, thereby recording twice their actual consumption.

Number Three—Shows a 220-volt, three-wire meter connected in the ordinary manner for lamps, while but one lead of the motor is connected to the house side of the meter and the other is connected to the line side of the meter, thereby recording the current used by the motor at half its value and giving the customer power at one-half the lighting rate.

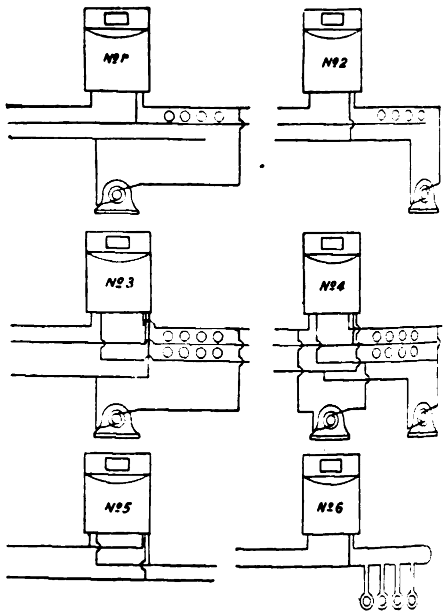


DIAGRAM SHOWING DIFFERENT METHOD OF CONNECTION.

Number Four—Also shows a 220-volt, three-wire meter connected for lighting load for two motors connected as in No. 3, except that the connections are reversed so that the motor load may be divided on the series coil of the meter, also recording but one-half the energy used by the motors as in the case of Nos. 1 and 3.

The above methods of connecting Thomson recording wattmeters have sometimes been found convenient where light and motors are furnished to small consumers, in order to save the necessity of two meters, one for light and one for power for the same customer.

Number Five—Shows a method of connecting up a three-wire, 220-volt meter or a two-wire, 110-volt service paralleling

the series coils, thereby combining the ampere capacity of the two coils of the meter and doubling its capacity for an emergency call, as might occur in an alternating current, two-wire service, thereby making a 15-ampere, three-wire meter take the place of a 30-ampere, two-wire meter.

Number Six—Shows a 10-ampere, 220-volt, two-wire meter connected up on a series arc circuit, and may be used for one, two, three or four arcs of 50 volts each, in place of the regular series arc meter. While we have used this meter in several cases, we should not advise such a practice except as an emergency, as there is no cut-out to protect the meter in case of an accident to an arc lamp lead or anything else that might open the arc circuit on the house side of the meter.

JAMES E. PYLE, R. L. PETERMAN,
West Chester, Pa.

North Company's Employes' Outing.

We are in receipt of a communication from the North Electric Company of Cleveland which states that the employes of that company expect to give their annual field day and outing at Silver Lake, on August 27, the last Saturday in the month. There will be a ball game for the shop trophy, races of various kinds, bowling matches, dancing, etc. All friends and patrons, as well as the members of the electrical press will be accorded an enthuisiastic welcome.

Convention Train to St. Louis.

Editor ELECTRICITY.

As the National Electric Light Association will not hold a convention at St. Louis during the Exposition, by the courtesy of Mr. Alex Henderson, master of transportation of the National Contractors' Association, arrangements have been made for the transportation of our members who desire to attend the sessions of the International Electrical Congress, which convenes on the morning of September 12, on this special train of best Pullman equipment.

Members and their friends who desire accommodation on this train should at once make application, and forward full amount of their fare, to Mr. Alex Henderson, 527 West 34th street; or Mr. M. C. Roach, General Eastern Passenger Agent, 1216 Broadway, New York City.

Passengers from New York City, Philadelphia, Baltimore, Washington and points South will connect with the convention train at the Grand Central Station, New York City, on September 10.

Passengers from Worcester, Springfield, Pittsfield, Boston and points East will connect with the convention train at Albany, N. Y., at 4:05 P. M., on September 10, by the train leaving Boston at 10:45 A. M., on same date. These passengers must change cars at Albany.

Eastern passengers, via the Fall River, Providence and Stonington boats sailing on the evening of September 9, are due in New York in ample time for them to connect with the convention train at Grand Central Station on September 10.

We trust all who can will avail themselves of this opportunity. Respectfully,

GEO. F. PORTER,
Master of Transportation.

Preparing for Electricity Day at the Fair.

Preparations for the celebration of Electricity Day at St. Louis, September 14, are being vigorously pushed. Committees on arrangement, finance, publicity and reception have been appointed and systematic work is being carried on.

S. H. Gale, chairman of the committee on arrangements; S. B. V. Turner, chairman of the committee on finance; W. H. Pope, chairman of the committee on reception, and W. E. Goldsborough, chief of the department of electricity, form the executive committee in charge of the day.

The Executive Committee has issued letters notifying exhibitors in the Palace of Electricity of the formal setting of the date and requesting each exhibitor to present some especially novel and attractive feature for the day's programme.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 16, 1904

Electric Railways and Appliances

767,534. Conductor for Electric Railways. Arthur Whittier, Wollaston, Mass. Filed Sept. 8, 1903.

767,538 Car-Fender. William E. Zachry, Brooklyn, N. Y. Filed Dec. 15, 1903.

767,862-863-865. Means for Operating Overhead Trolleys Electrical Locomotive and Brake for Overhead Electrically-Driven Locomotives. Alexander E. Brown, Cleveland, O., assignor to the Brown Hoisting Machinery Company, same place. Filed April 20, 1904.

767,939. Trolley-Pole Head. John E. Greenwood, Utica, N. Y. Filed Aug. 29, 1903.

767,954. Trolley-Wheel. Elijah W. Potts, Detroit, Mich., assignor to the Detroit Trolley Wheel & Electrical Equipment Company. Filed Jan. 12, 1903.

Electric Lights and Appliances.

767,408. Starting Device for Vapor Electric Apparatus. Peter C. Hewitt, New York City, assignor to the Cooper Hewitt Electric Company. Filed May 28, 1903.

767,875. Electric-Lamp Attachment. Henry D'Olier, Jr., Philadelphia, Pa. Filed July 15, 1904.

Electrical Machinery and Apparatus.

767,472. Method of Soldering Armature-Leads to Commutator-Bars. Jacob Beech, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Oct 22, 1902.

767,495. Prepayment Mechanism for Electricity-Meters. Baker North, Manningham, Eng. Filed July 7, 1903.

767,691-692. Motor Control. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Filed May 5, 1902, May 8, 1902.

767,703. Automatic Electrical Regulator. Emanuel Levison, Mansfield, O., assignor to the Phoenix Electric Manufacturing Company, same place. Filed Jan. 18, 1904.

767,759. Rectifier for Periodic Currents. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 6 1900.

767,761. Control of Alternating-Current Motors. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 29, 1903.

767,764. Power-Factor Indicator. Lewis T. Robinson Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 5, 1902.

767,773. Power Transmission. William Stanley, Great Barrington Mass. Filed Nov. 30, 1903.

767,787. Commutating Dynamo-Electric Machine. Eddy R. Whitney, Lynn, Mass., assignor to the General Electric Company. Filed Dec. 30, 1903.

Telephones and Telephone Apparatus

767,489. Telephone Support and Switch. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Filed Dec. 1, 1902.

767,573. Party-Line Ringing Device for Telephone-Switchboard Circuits. Jacob W. Lattig, West Bethlehem and Charles L. Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, Westchester, Pa. Filed June 6, 1903.

767,584. Telephone Hook-Switch. Charles T. Mason, Sumter, S. C. Filed April 9, 1904.

767,753. Telephone-Transmitter. Charles W. Harper, Malden, Mass. Filed Sept. 12, 1902.

767,818. Telephone-Circuit. William W. Jacques, Boston, Mass. Filed April 18, 1904.

767,953. Telephone System. Frederick R. Parker, Chicago, Ill. Filed Dec. 14, 1903.

Miscellaneous.

767,524. Card or Ticket for Agitating the Mechanism Controlling Electric-Light Signs. Mortimer Norden and Lucien S. Crandall, Brooklyn, N. Y. Filed March 13, 1902. Renewed May May 7, 1904.

767,463. Sectional Electric Conduit. Charles E. Wilson, Philadelphia, Pa. Filed Dec. 14, 1901.

767,477. System of Electrical Distribution. Josef H. Hallberg, New York City. Filed Oct. 16, 1903.

767,554. Method of Rendering Storage-Battery Gases Non-Explosive. Thomas A. Edison, Llewelyn Park, N. J., assignor to the Edison Storage Battery Company. Original application filed Nov. 28, 1902. Divided and this application filed June 13, 1904.

767,599. Electrically-Operated Apparatus. Charles R. Sedgwick and Walter H. Abbot, Cleveland, O. Filed Sept. 17, 1903.

767,625. Electric-Circuit Closer for Fire-Alarms. John E. Bemiller and Emery C. Weisensale, Hanover, Pa. Filed May 7, 1904.

767,751. Means for Controlling Movements from a Distance. Max R. Hanna, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 18, 1904.

767,757. Electric Lock. Edward B. Jacobson, Pittsfield, and Ernest Blasser, Boston, Mass. Filed Nov. 21, 1902.

767,777. Electrically-Heated Tool. Tycho Van Aller, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 14, 1903.

767,828. Electric Connection Rosette. Mortimer Norden, New York City, assignor to the Norden-Bittner Electric Company. Filed Jan. 12, 1903.

767,846. Base for Electrical Fixtures. Louis Steinberger, New York City. Filed June 1, 1903.

767,916. Rheostat. Irving B. Smith, Philadelphia, Pa. Filed Dec. 3, 1903.

767,952. Block-Signal. Charles R. Morse, Cambridge, Mass. assignor to the Uni Signal Company, same place. Filed May 22, 1903.

767,964. Electrolytic Apparatus. William J. Schweitzer, White Plains, N. Y. Filed July 31, 1903.

767,970. Apparatus for Simultaneously Transmitting and Receiving Space-Telegraph Signals. John S. Stone, Boston, Mass., assignor, by mesne assignments, to the Stone Telegraph & Telephone Company, Portland, Me. Filed Jan. 23, 1901. Renewed Dec. 22, 1902.

767,971. Wireless-Telegraph Receiving Device. John S. Stone, Cambridge, Mass. Filed Aug. 12, 1902.

767,972. Method of Receiving Space-Telegraph Signals. John S. Stone, Cambridge, Mass. Original application filed Aug. 11, 1902. Divided and this application filed Sept. 10, 1902.

767,973. Method of Increasing the Effective Radiation of Electromagnetic Waves. John S. Stone, Cambridge, Mass., assignor to William W. Swan, trustee, Brookline, Mass. Filed Oct. 30, 1903.

767,974. Apparatus for Increasing the Effective Radiation of Electromagnetic Waves. John S. Stone, Cambridge, Mass., assignor to William W. Swan, trustee, Brookline, Mass. Filed Oct 30, 1903.

THE TELEPHONE WORLD.

Independent Telephone Men Busy in Ohio.

The organization by districts of the Independent telephone interests of Ohio began in Cleveland last week, when Vice-President J. B. Hoge, of District No. 1, met representatives of the Independent companies from Erie, Lorain, Cuyahoga, Huron, Medina, Lake, Geauga, Ashtabula and Trumbull Counties.

The plan was to perfe t an organization that would bring all the Independents of these counties together in a body ready to work for the general development of the business. This includes the adoption of similar methods of handling business, a standard method of telephone records and harmonious efforts for the quick handling of through business Followed out to the conclusion the promoters hope to reach, it means the adoption of a standard in construction and equipment, so that all plants may be able to work together and special apparatus be wholly disposed of. This standardization of construction and equipment will save many thousands annually to the telephone companies of the country. The same idea has been adopted in all other important lines of commercial manufacturing.

Following the organization of the district in Cleveland, Vice-President R. E. Hamblin presided at the meeting in Toledo on Wednesday of last week, where there were representatives from nine counties. On Thursday G. H. Metheary, of District No. 7, met representatives at Lima from ten counties.

J. C. Reber was slated to preside over the meeting at Dayton on August 23. To-day W. Gilbert Thompson will preside over the meeting at Hamilton, and on August 25, Dwight E. Sapp will preside over the meeting at Mt. Vernon. August 30 G. P. Thorpe will preside at the meeting at Wilmington; August 31 J. B. Rhodes at Zanesville, and September 1 W. F. Laubach will preside over the meeting at Akron that will complete the district organization of the State.

The Home Telephone Company, an Independent concern of Tiffin, O., is installing a modern lamp signal central energy switchboards with an installed capacity of 1,200, and an ultimate capacity of 2,200. The rapidly increasing Independent telephone business in that locality has led to this valuable innovation. It is confidently expected by the officers of the company that these and other improvements which are being made will make the exchange one of the most up-to-date in the Independent field. Every effort is being bent toward the early completion of the work as the number of new contracts awaiting service are increasing rapidly.

A meeting was recently held in Montgomery, N. Y., to take steps toward organizing an Independent telephone company. It is proposed to make connections with the Orange County Telephone Company of Middletown, the Colonial Telephone Company of Newburgh, and the Highland Telephone Company of Highland Mills.

Stockholders of the Dayton, O., Telephone Company met recently, and authorized an increase in the capital stock of $200,000 preferred. The capital stock of the company is now $1,200,000.

Independent Telephone Project for Omaha, Neb.

Lee Herdman announces that he proposes to participate in the fight for an Independent telephone franchise in Omaha. For several months he and others have been working on the scheme, but, like A. B. Hunt and his colleagues, were caught off their guard by the sudden projection of the Blackburn-Stevens franchise.

According to Mr. Herdman, his company is to be composed of a number of foreign and local capitalists, the principal backer, it is understood, being W. T. Auld. president of the City National Bank of Lincoln, and reputed to be a millionaire.

"We are waiting for the situation to clear," said Mr. Herdman, "but I can say that we will have a proposition to present for a legitimate Independent telephone business in this city.

"We shall propose to establish an automatic, exchange permitting the subscriber to make his own connections and doing away with the girls in the central office. The Blackburn-Stevens proposition is so low that a legitimate telephone business cannot be conducted under it. Furthermore, it is an offer that we cannot possibly meet, as it is our intention to build the system here and do business."

The annual meeting of the Ashville & Panama, N. Y., Telephone Company, was lately held. The reports from the officers showed the finances of the concern to be in very good condition. The following directors were chosen: George W. Appleby. Alton H. Appleby, James T. Howles, Watts Flats; A. John Peterson, Brewer D. Phillips, Frank H. Mott, Jamestown; Sardius S. Lewis, Elmer Berry, Panama. The directors organized immediately following their election, and chose the following officers for the year; President, George W. Appleby; vice-president. Brewer D. Phillips; secretary and treasurer, Alton H. Appleby.

News from Glassboro, N. J., states that the Pilesgrove Rural Telephone Company has been merged into the People's Rural Telephone Company of New Jersey. The latter company has poles up for about 25 miles of its lines. The merger insures a through line from Salem to Philadelphia, passing through Woodstown and Mullica Hill.

E. N. Reaser is interested in the Independent telephone system to be established in Lawrence, Kan. Plans have been partly drawn for the construction of the new exchange building to be erected just north of the city hall, and bids will be called for shortly. The work of construction will then be commenced at once, and pushed to an early completion.

At Bloomington, Ill., preliminary plans were lately made to organize the Central Illinois Independent Telephone Association, which will include every Central Illinois Independent telephone company. Albert Schuler, of Steator, was chairman of the meeting, and R. C. Critchfield, of Minier, secretary. A committee was appointed to outline permanent organization plans.

The Consolidated Telephone Company, of Reading, Pa., has been granted a franchise to construct a system at Mauch Chunk, Pa.

Central New York Independents to Merge.

A movement is under way on the part of the Independent telephone promoters to incorporate all of the Independent telephone companies in Central New York under the name of the New York Independent Telephone Company. This plan is the outcome of the success of the Utica Home Telephone Company, which has now over 3,000 subscribers in Utica.

Besides that company the more prominent ones which would become a part of the system are the Rome Home Telephone Company, the Herkimer County Telephone Company, the Interstate Company of Little Falls, the Otsego, Clinton, Oneonta and Cooperstown companies, and many of the smaller exchanges operating in the northern part of this State. In time the Syracuse, Rochester, Buffalo and Albany telephone companies will become part of the system.

The Independents have met with remarkable success within the past two years and the exchanges in Central New York have all the subscribers they can properly look after.

Northern Pacific to Use Telephone System.

Recent information indicates that within the next few weeks the Northern Pacific will let contracts which will practically revolutionize the present system of train dispatching over the main line west.

It is said that the telephone system will be substituted for the telegraph on long and important stretches of the St. Paul-Portland route. That large extensions of the telephone system are contemplated is not denied at headquarters.

A meeting of representatives of the eight telephone companies of Preble County, O., held lately in Eaton, resulted in formal action being taken toward the forming of a general organization, whose object will be to increase the efficiency of county telephone service; mutual assistance in settling disputes in regards to territorial rights of individual companies, and to establish a uniform toll schedule. A code of laws to govern the new organization will be prepared by the following representatives of interested companies: S. C. Morton, Camden; W. D. Rush, George Cook, Morning Sun; C. D. Fudge and L. D. Lesch, Eaton. The action of the company is especially significant because of the absence of a precedent.

It is authentically reported in Yankton, S. D., that a combination has been formed between the new Yankton telephone exchange, the Bruce lines, the Citizens' Exchange of Sioux Falls, and the exchange now being built by the business men at Sioux Falls, together with the Ward lines and the several smaller companies in the small towns between the three cities.

Telephone Incorporations.

The Farm & Village Telephone Company, Lansing, N. Y. Capital stock, $20,000. Incorporators: R. Miller and Ivan Miller.

The Henderson Telephone Company, Henderson, Minn. Capital stock, $10,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aberdeen, Wash.—The Aberdeen Electric Light Company has sold its plant and franchise to the Gray's Harbor Electric Company.

Bainbridge, Ga.—A sufficient number of votes having been cast for bonds amounting to $20,000 this city will purchase and operate its own electric light plant.

Brookville, Fla.—An electric light and power plant is to be installed here at a cost of $10,000.

Clifton Springs, N. Y.—The citizens have voted in favor of electric lighting.

Covington, Ky.—The council has voted to issue $75,000 bonds for the purpose of constructing an electric light plant.

Hartford, Conn.—The stockholders of the Hartford Electric Light Company have the right to subscribe at par for $200,000 additional capital stock issued for extensive additions and other improvements.

Kissimmee, Fla.—H. M. Pfann, chairman of the electric light committee, is busy considering bids for erecting a new plant and new machinery. He expects to have the new plant in perfect running order in about 60 days.

Lambertville, N. J.—A new firm has taken charge of the local electric light plant, and will spend several thousand dollars in improvements. The rates have been reduced nearly one-half of the old prices. New machinery will take the place of the present inefficient apparatus and a day circuit for motors, fans, etc., will be run.

Maple Falls, Wash.—It is stated that this town will soon be lighted by electricity.

Milwaukee, Wis.—The common council is considering the prosposition to locate an electric lighting plant on Jones Island.

New Albany, Miss.—The proposition to issue $20,000 worth of bonds for the establishment of an electric light plant and waterworks system was lately carried.

Newnan, Ga.—A special election will be held this month to decide whether $20,000 bonds will be issued to secure an electric light plant.

Northumberland, Pa.—The borough council has adopted a resolution to submit to the taxpayers at the election to be held on November 8 the proposition to vote on increasing the borough debt $15,000, or as much thereof as is necessary for the purpose of building a municipal electric light plant for the borough.

Pittsburg, Pa.—A new dynamo is to be installed at the electric light plant at a cost of $4,250.

Rock Rapids, Ia.—The municipal electric light plant will be improved at a cost of $5,000.

Sealy, Tex.—A new electric light plant and ice factory combined is being contemplated, and most of the capital needed has been subscribed.

Sinking Spring, Pa.—The Sinking Spring Electric Light, Power & Heat Company, with W. F. Krick as president, has been granted a charter.

Stone City, Ia.—A dam will be built at the stone quarries, and an electric light plant installed.

St. Cloud, Minn.—A proposition is on foot here to bond the city for an electric lighting plant.

St. Joseph, Mo.—Bonds to the amount of $75,000 will be issued here for electric lighting.

Stillmore, Ga.—An electric light plant to cost several thousand dollars is to be built here soon.

Sumner, Ia.—The citizens are agitating the electric light question. It is probable the matter will be submitted to a vote.

Winters, Cal,—The Dixon Light & Water Company, of which E. D. N. Lehe is manager, is making arrangements to install an electric light plant here.

Woodville, Miss.—This town has voted to issue $75,000 bonds for an electric light plant and waterworks.

STREET RAILWAYS.

Beaumont, Tex.—The board of county commissioners has granted a franchise to the Port Arthur & Southern Electric Railway Company for laying an electric line in Port Arthur.

Canton, N. Y.—The Canton Electric Traction Company, capitalized at $20,000, has been formed with the following directors: G. Mazacorati, R. L. Spotts and P. M. De La Chesnaye.

Chihuahua, Mex.—The ancient capital of the State of Chihuahua, is to have electric cars. The present system has been purchased by a syndicate headed by S. L. Pearce, and he has gone East to purchase new cars. The new company will also operate electric tramways to many mines in this section. Chihuahua citizens have subscribed for $100,000 worth of stock.

Dunkirk, Ind.—A new electric line is projected from here and Redkey to Eaton. The Muncie, Hartford & Ft. Wayne Road is interested.

Egg Harbor City, N. J.—The council has granted to John H. Bozarth the right of way on Philadelphia and Antwerp avenues for trolley lines which are to cover 12 miles of these streets. The trolley is to connect with that at Absecon, and will extend from here to Tuckerton and all immediate places.

Evansville, Ind.—The Evansville & Eastern Electric Railroad Company has applied to the board of public works for a franchise giving it the right to operate cars over certain streets of the town.

Missoula, Mont.—D. E. McKinnon, secretary and general manager of the Amador Mining & Milling Company, has been here lately and stated that one of the improvements contemplated in the near future by the company is an electric road from the town of Amador to the mines. When this is done, the company will be ready to ship ore.

Mount Vernon, O.—There is some talk of building an electric road from here to Columbus. Those engaged in securing the right of way are John Silers, C. W. Slack and B. W. Chase.

Stroudsburg, Pa.—A trolley line running through the Pocono Mountain region in Pike and Wayne Counties, seems to be assured. The following organization of a company has been effected: John B. Williams, president; John D. Houck, treasurer; George L. Waltz, vice-president, and Dr. Arthur L. Simons, secretary. The new company will be known as the Pocono, La Anna & Newfoundland Railway Company. The East Branch Falls may be utilized as a power plant.

Syracuse, N. Y.—C. D. Beebe, president of the Auburn & Syracuse Electric Road and the Auburn City Railway, has announced that in all probability a line will be built soon from Auburn to Port Byron.

Worcester, Mass.—An electric railway proposition involving $1,225,000 emanates from the office of the Worcester & Holden Electric Road of this city. Plans are on foot and will shortly be working to perfect a power station at a cost of $160,000 to furnish power for a line from here to Wachusett Mountain and Westminster.

Zanesville, O.—F. H. Blodgett, who built the electric railway from Newark to this city, has been awarded the contract for the line from here to Crooksville.

POWER PLANTS.

Agus Calientes, Mex.—A company is being organized here to establish an electric power plant on the Santiago River.

Baltimore, Md.—The much-discussed plan to develop the power of the falls of the Susquehanna River and electrically transmit it to this and other cities has been taken up again. Those interested say that they expect to begin construction work this fall, and they are now ready to make contracts. The Susquehanna Power Company is the corporation which now undertakes this project. It is said to be backed by Baltimore, Philadelphia, Wilmington and Pittsburg capitalists. The company will be capitalized at $8,500,000, and plans the construction of works to furnish 50,000 hp. Its capitalization is to consist of $6,000,000 of bonds and $2,500,000 of stock.

Clarkston, Wash.—The Lewiston-Clarkston Company has decided to enlarge its power plant here.

Cody, Wyo.—A company financed by Denver and Eastern capitalists will soon undertake the construction of a plant at the falls of the Government dam being built on the Shoshone River. Power will be generated for a smelter, and transmitted to the mines at Kirwin. The plans of the company include the construction of an electric line from here to Sunlight, Kirwin and the Yellowstone National Park.

Helena, Mont.—The Gallatin Power Company, which will establish a power plant at Sheep Rock and divert water from the West Gallatin River, has been incorporated with a capital of $150,000, by E. J. Carter, Samuel A. Medenhall and others.

Montgomery, Ala.—The Cherokee Development & Manufacturing Company, which is to build an immense power plant on the Tallapoosa River and furnish electric power to the city of Birmingham, has increased its capital stock from $50,000 to $100,000. The headquarters of the company will be located in this city,

Walla Walla, Wash.—An electric plant to cost not less than $250,000, and to be ready for operation by January 1 at the latest, is being constructed on the Walla Walla River, about 10 miles from this city. Over 200 men are engaged in the work, and 300 more men are wanted. The Washington & Oregon Power Company, composed of Eastern capitalists, is back of the proposition, and valuable water rights have been secured. The company proposes to furnish power for the plant in this city, Pendleton, Athena, Milton, Weston and other towns

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12½@12¾c.; casting, 12⅜@12½c.

The Welsbach Light Company has declared a dividend of 2 per cent., payable September 2, to stockholders of record August 24.

The death of John Lowber Welsh had no effect on the Philadelphia market Monday, although he was said to be largely interested in electric traction securities.

The floating supply of the National Carbon common stock, was never so small, it is stated, as it is at this time. The preferred is said to be practically all held by investors.

The annual report of the Brooklyn Rapid Transit Company gives the gross earnings of the company to be $14,738,709, the operating expenses $8,700,438, and net income $5,978,270.

The Equitable Trust Company, of this city, has been appointed trustee for an issue of $2,100,000 first mortgage, 5 per cent. gold bonds, of the Arkansas Valley Interurban Railway Company.

For the purpose of enlarging its plant and increasing its business the stockholders of the Buffalo General Electric Company have decided to increase the capital stock from $2,400,000 to $5,000,000.

The South Side Elevated Railroad Company of Chicago has given notice to the holders of its first mortgage bonds that the latter have been called for payment on November 15 at the Illinois Trust & Savings Bank at 102 and interest.

The J. G. Brill Company of Philadelphia has recently received an order for 150 new trolley cars for the Metropolitan Street Railway Company of New York, and another for the same number of cars from the United Railways & Electric Company of Baltimore.

The Electric Mutual Insurance Company and the Traction Mutual Insurance Companies have been incorporated at Columbus, O., to assume all the risks of traction properties, electric light and power companies in the United States and Canada. Twelve traction properties form the nucleus of the new insurance company which took $40,000,000 worth of insurance.

The first commercial run of a trolley car by alternating current was made by the General Electric Company from Schenectady to Ballston, N. Y., last Friday. The alternating current system, it is asserted, will greatly widen the profitable area of electric railway exploitation, lessen cost of operating expense and bring nearer the substitution of electricity for steam in trunk line railway transportation.

There has been a good deal of comment in the financial circles in this city at the delay of the Metropolitan Street Railway Company in publishing its quarterly statement. According to law it should have published the statement for the quarter ended June 30 before August 12. It has also failed to turn into the Board of Railroad Commissioners the number of passengers it carried for the three months ending May 31.

A dispatch from Cumberland, Md., says it is rumored that Pittsburg capitalists operating the Myersdale & Salisbury Street Railway have acquired an option on the Cumberland & Westernport Electric Railway. Ex-Judge R. H. Koch, of Pottsville, is president of the latter road. A mortgage for $1,500,000 is reported to have been placed on record at Somerset by the proposed purchasing syndicate. It is stated that only the controlling stock in the road is desired.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Aug. 22
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	154⅜
Metropolitan Street Railway	122¼
Metropolitan Securities	90⅛
Ninth Avenue	195
Third Avenue	125
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	237
Brooklyn Rapid Transit	53¼
Public Service Corporation (New Jersey)	98
Philadelphia.	
Consolidated Traction of New Jersey	70
Philadelphia Traction	98⅞
Union Traction	54¼
Boston.	
Boston Elevated	150½
Massachusetts Electric Companies, com	15
do. do. do. pref.	62½
West End Street, com	91½
do. do. do. pref.	111¼
Chicago.	
City Railway	168
North Chicago	71
Union Traction, com	5½
do. do. pref.	30

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

New York City.	
Allis-Chalmers, com	11
do. pref.	50
Electric Boat, com	40
do. do. pref.	75
Electric Lead Reduction	¾
Electric Vehicle, com	9¾
do. do. pref.	14
Westinghouse, com	159¼
do. pref.	180
General Electric	163¾
Boston.	
Edison Electric Illuminating	263
General Electric	164½
Westinghouse Electric & Mfg., com	80
do. do. do. pref.	90
Chicago.	
Chicago Edison	145
National Carbon, com	35¼
do. do. pref.	107
Philadelphia.	
Electric Company of America	9¼
Electric Storage Battery, com	61
do. do. do. pref.	61

TELEPHONE AND TELEGRAPH STOCKS.

Boston.	
American Telephone & Telegraph Company	138
Western Telephone Company	14
New England Telephone Company	123¾
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	180
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	89¾
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..

MISCELLANEOUS STOCKS.

Otis Elevator Company	35
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

The Standardization of Electrical Machinery.

The valuable work of the British Engineering Standards Committee, to which we have referred on several occasions in these columns, has been advanced another stage by the issuance of an important interim report by the Sub-Committee on Generators, Motors and Transformers. No attempt has been made by that sub-committee to prescribe standard dimensions or shapes which might hamper future development in design, but the recommendations have been confined to such points as would insure uniformity in nomenclature, outputs, and test conditions. In regard to the last of these, test conditions, a special sub-committee is now conducting an experimental investigation into the safe limit of temperature at which electrical machinery can be allowed to work for lengthened periods of time. This investigation is being conducted by Dr. Glazebrook and others at the National Physical Laboratory, their research being supplemented by tests at the works of such manufacturers as were willing to render assistance. The points which they have under investigation may be stated:

1. The maximum temperature to which the insulating materials at present used in the manufacture of electrical apparatus could be exposed for lengthened periods of time without electrical or mechanical deterioration.

2. The permissible rise in temperature deduced from these experiments.

3. The relation between the mean temperature of any coil obtained by measurement of rise in resistance and the maximum temperature at the hottest portion of the same coil. It is already stated that the experimental work has made sufficient progress to indicate with considerable certainty that the temperature limits ultimately to be recommended by the sub-committee are likely to be more liberal than those laid down by either the American or German Electrical Standardization Committees. The experiments are also stated to have demonstrated that the temperature of the hottest part of the coils taken by thermo-junction, is no more than 25 degs. C. in excess of the mean temperature of the coil, taken by rise in resistance

It is reported that the question of settling the standard pressures did not meet with as much difficulty as had been anticipated. Care was taken to select those standard pressures, which, with the allowable variation of 10 per cent. on either side, would enable nearly all the pressures at present existing to be served by the proposed standard machines. These standard preasures have now been fixed, and the sub-committee expresses the hope that they will be universally adopted by those engaged in connection with the distribution of electrical energy, so that in these cases the permissible variation may cease to be necessary.

The question of standard frequencies was not so easily arranged, and a special conference had to be convened on the point. Such strong evidence was then produced in favor of standardizing one frequency only, that it was decided to recommend 50 periods per second as the standard frequency, placing 25 periods per second in a secondary category.

Then, also, considerable difficulty was met with in the matter of standard lists of motor speeds. It was not felt that the sub-committee could materially assist manufacturers in reducing the number of patterns to be kept in stock, if a greater number of speeds were retained than those recommended in the standard lists.

In the case of prime movers the list of speeds was practically fixed for the committee by the conditions of the frequency and the number of the poles in the alternators, and the committee decided to put forward one list of speeds for the whole of the direct-coupled machinery of both classes.

The matters which are still under consideration include the standardization of transformers, test conditions, and permissible variations from the adopted standards.

* * *

Do Electrical Devices Cause Fire?

The popular idea that electricity causes many fires is about as correct as the once prevailing notion that all steam boilers explode and illuminating gas always asphyxiates.

The argument can be carried along other lines, and might, in the eyes of some, on account of what would be regarded as an ever present danger, prohibit the use of electricity and steam and gas for industrial and domestic purposes. There is one advantage that cannot be overlooked, which has arisen due to the widespread application of electricity, and that is the demand on the part of the Board of Fire Underwriters that certain specific requirements be fully met with, or the use of electricity for light, heat and power cancels the insurance and exposes the proprietor to an imminent risk.

Do electrical devices cause fire? This is a question which in a sense has met with a full answer from the manufacturers of these devices and the installers. It is comprehensive in that it includes not only apparatus, but wire, moulding, and all forms of insulating material. It is a well-known fact that the safety valves of an electrical system are its fuses, and it is mainly at these points that danger from fire can be anticipated. But if these fuses are covered with incombustible material so that when they blow, no flash or flame can possibly appear, where then does the danger lie? It has been claimed that switches will arc, and fires originate at these points. But the unbiased observation of many witnesses has been to the contrary. Switches undergo the severest of tests before they can be used as a reliable electrical device. In this respect manufacturers more than toe the mark. What then is left? Some say the wooden moulding catches fire, but this is fireproofed. The report of the Committee on Arts and Sciences, published in the Journal of the Franklin Institute on Fenell's apparatus for fire-proofing wood, covers this subject thoroughly. The use of moulding does represent a possible source of conflagration, but when we hear of the requirements of an ideal fire-proofing substance, as cited by him and applied in practice by his methods to make wood "fire resistant," even this risk disappears.

An ideal fire-proofing substance to which reliable moulding is subjected must accomplish the following:

Render wood "fire-resistant" in the highest degree.

Have no deleterious effect on the wood, but, on the contrary, serve as a preservative.

Have no injurious effect on the strength of the wood.

Have no hydroscopic qualities.

Produce no efflorescence.

Preserve the natural color of the wood.

Have no injurious effect on varnish or paint applied to its surface.

Be non-volatile under the action of heat.

Exert no corrosive or rusting action on metallic substances.

This leaves little to be desired and disposes of the vital points in the question asked. A building entirely dependent upon electricity for its light, heat and power is by far the best insurance risk the community can offer. It is the safest building to reside in, and it represents the epitome of hygienic and engineering accomplishments.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The annual meeting of the Association of Edison Illuminating Companies is now in session at the Hotel Wentworth, New Castle, N. H.

The Elliott Cressons medal was awarded to Mr. Frank J. Sprague by the Franklin Institute, Philadelphia, in consideration of the great advance which Mr. Sprague's inventions have made in the operation of railroads by electricity.

At a cost of more than $8,000,000, the New Haven Railroad will be made into a six-track line between the Harlem River and New Rochelle without a grade crossing. Two of the tracks will be exclusively for electric expresses, two for electric trains. Steam traffic will be confined to the two middle tracks. The electric tracks will be patterned after the Interborough ones, and will ultimately extend to the Battery in this city by way of a connection at West Farms. The steam road will connect with the Pennsylvania system at Astoria.

The first annual convention of the Society of Chemical Industry to be held in America will begin in this city as the Chemists' Club on Wednesday, September 7, and will continue until September 12. The foreign delegation will then be taken aboard a special train as the guests of the New York members for a trip through the South and Middle West. The society is an international organization, and members will be present from many foreign countries. One feature of the meeting will be a visit of inspection to the larger manufacturing plants all through this country. It is expected that many important questions relating to the chemical industry will be considered.

Chief Goldsborough of the Department of Electricity at the World's Fair has recommended that the Palace of Electricity be opened to the public two nights of each week.

The Tokio Electric Light Company, of Tokio, Japan, which concern operates the most extensive lighting plant in the Far East, has placed a contract for two 1,000 kw. turbines of American make for installation in its power station.

The ninth annual convention of the International Association of Municipal Electricians will be held at St. Louis, September 13 and 14. The Grand View Fraternal Hotel, situated very conveniently to the Exposition grounds, South Side, has been selected as the official headquarters.

A Government board of naval engineering experts at Washington has just completed a thorough examination of the Turbina, one of the latest developments in the use of the steam turbine as applied to vessels. The results of the inspection will be given in detail in a report by the board, but it is said that the performance of the turbine was regarded as highly satisfactory and that the naval engineers will advise the installation of turbines on warships.

Prof. G. Arrhenius, who will represent Norway and Sweden at the International Electrical Congress, is at present on a visit to the University of California.

The Navy Department at Washington, D. C., has been advised by its wireless telegraphy agent in Europe that the date for the next wireless conference at Berlin is quite indefinite, owing to the fact that Russia does not yet seem disposed to join in fixing a date.

MODERN SEARCHLIGHT PLANTS.

BY FRANK C. PERKINS.

It would be practically impossible at the present time for the Navy or Merchant Marine to get along without the modern searchlight, and it is of equal importance for military operations upon the land. Marine searchlight projectors are extensively employed for lake and sea-going vessels, which, it is claimed, possess many advantages over the lights using silver-copper reflectors. The great accuracy of the curvature of the mirrors produces a light of such carrying power that it will render visible objects at over twice the distance possible with the silver-copper reflectors.

Dispersion lenses are sometimes used which are called "divergers," consisting of strips of plano-convex glass set in a

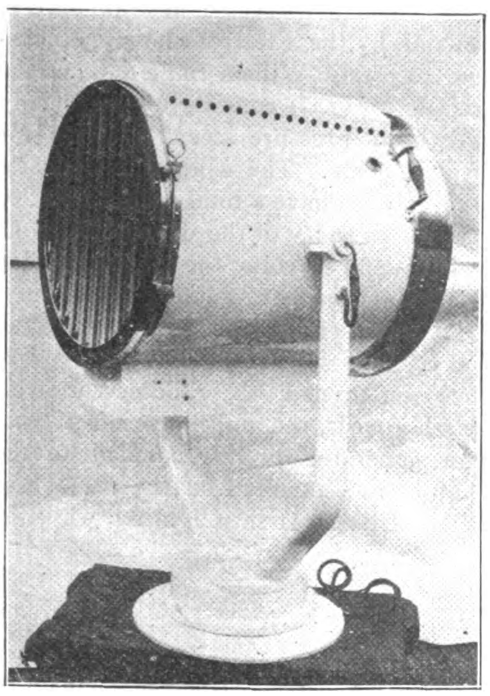


Fig. 1.—Marine Projector Fitted with Dispersion Lenses Mounted in Brass Rings.

suitable frame for slipping over the front of the projector. The object of using these lenses is to cause the light to spread out horizontally in order to illuminate a larger area. The light forms a wide ellipse but does not spread out vertically, and this arrangement for searchlights is said to be of special importance for tugs and towboats as well as some other classes of service. The accompanying illustration, Fig. 1, shows a 24 inch marine projector fitted with dispersing lenses mounted in brass rings. It has a glass mirror and the arc lamp consumes an electric current of about 50 amperes. A number of these searchlights were installed for the city of St. Paul, Minn., for illuminating the public baths, by the Carlisle & Finch Company of Cincinnati, O. The 19 inch projector is provided with dispersing lenses thrown across the beam of light so as to intercept it and cause it to diverge.

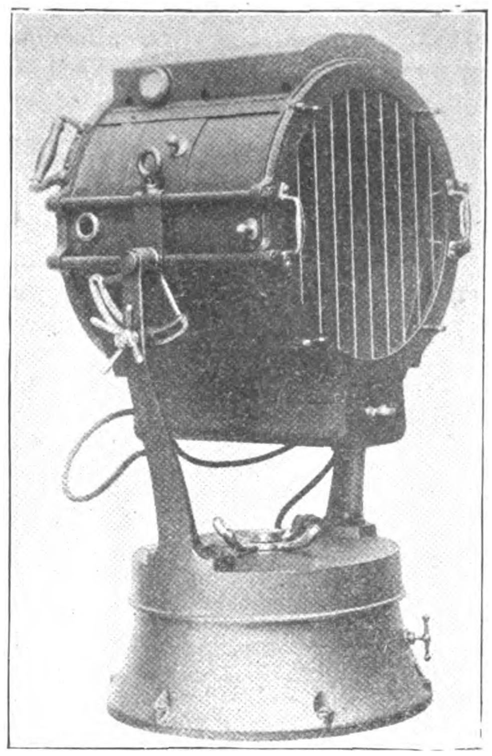


Fig. 2.—American Searchlight Built at Schenectady.

The dispersion lenses, as the name implies, are glass lenses so arranged in the searchlights as to disperse or spread out the lights. They are made of strips of heavy plate glass, one side of which is ground to a convex curve and highly polished, and when the light passes through these strips it is first converged or brought together and then, as the rays

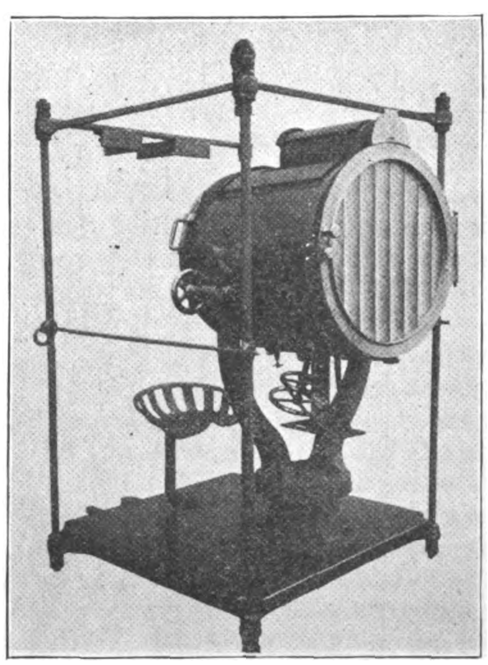


Fig. 3—English Searchlight and Cage.

cross, they are spread out again and continue to spread indefinitely in the shape of a partly opened fan. It will be noted that the light is spread out flat or horizontally but not vertically, and it thus lights up all the objects on the water or on the bank much better than the ordinary straight beam. It is, however, true that the light when thus spread out will not penetrate as far.

On some types of searchlights the dispersion lenses are mounted in a separate door or ring so that when the pilot desired to pick out distant objects he could remove the lenses, but when it was found necessary to light up a tow of barges, or for making a landing these lenses could be replaced. The searchlight shown in Fig. 1 is so designed that the dispersion lenses are mounted in two semi-circular brass rings and so pivoted that they can be swung around a vertical axis. On the top of the searchlight cylinder there are

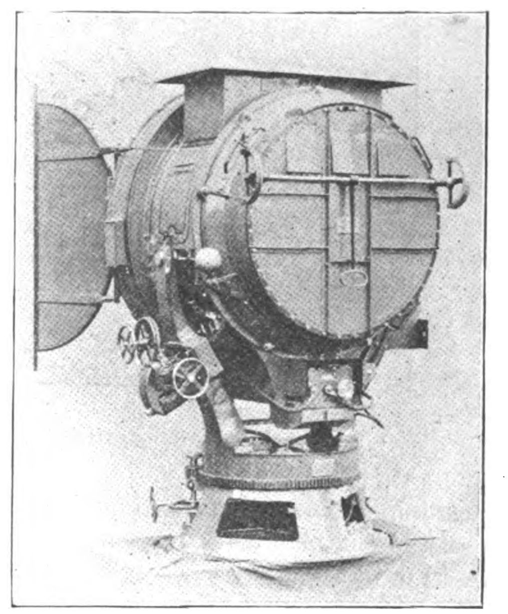


Fig. 5.—German Searchlight.

two brass handles by means of which the lenses may be swung into or out of position at a moment's notice, without opening the front door. The arc lamps utilized in the largest searchlights are of the horizontal type with automatic feeds, and owing to the peculiar position of the carbons all the light produced at the arc is cast upon the mirror, and is then both reflected and refracted, so that it diverges from the lamp in a practically straight ray. A focusing screw and hand wheel is usually provided for varying the spread of the light. Fig. 2 shows another form of American searchlight of large dimension constructed by the General Electric Company at Schenectady. An English design of searchlight with cage for hauling the lamp to varying heights on the vessel is noted in Fig. 3. This outfit was constructed at New Castle-upon-Tyne by the J. H. Holmes & Co. The German searchlight, noted in Fig. 4, was con-

tructed at Nurnberg by the Elektricitats Actien Gesellschaft, formerly Shuckert & Co.

Next to the searchlights themselves the most important apparatus connected with a searchlight plant, whether on board a vessel or on land, is the electric generating outfit. In either case it is necessary that the engine and generator be constructed as compactly as possible so as to take very little space in the engine room of the ship or on the vehicle provided for military purposes. Fig. 5 shows a bipolar dynamo directly coupled to a vertical single cylinder high-speed engine as constructed for searchlight purposes at New Castle-upon-Tyne in England by J. H. Holmes & Co. This engine is operated by steam from the main boilers of the steamer or war vessel. A modern English portable searchlight plant has recently been designed and constructed by the Simms Manufacturing Company, Ltd., of Kilburn, London, N. W., as shown in illustration, Fig. 6.

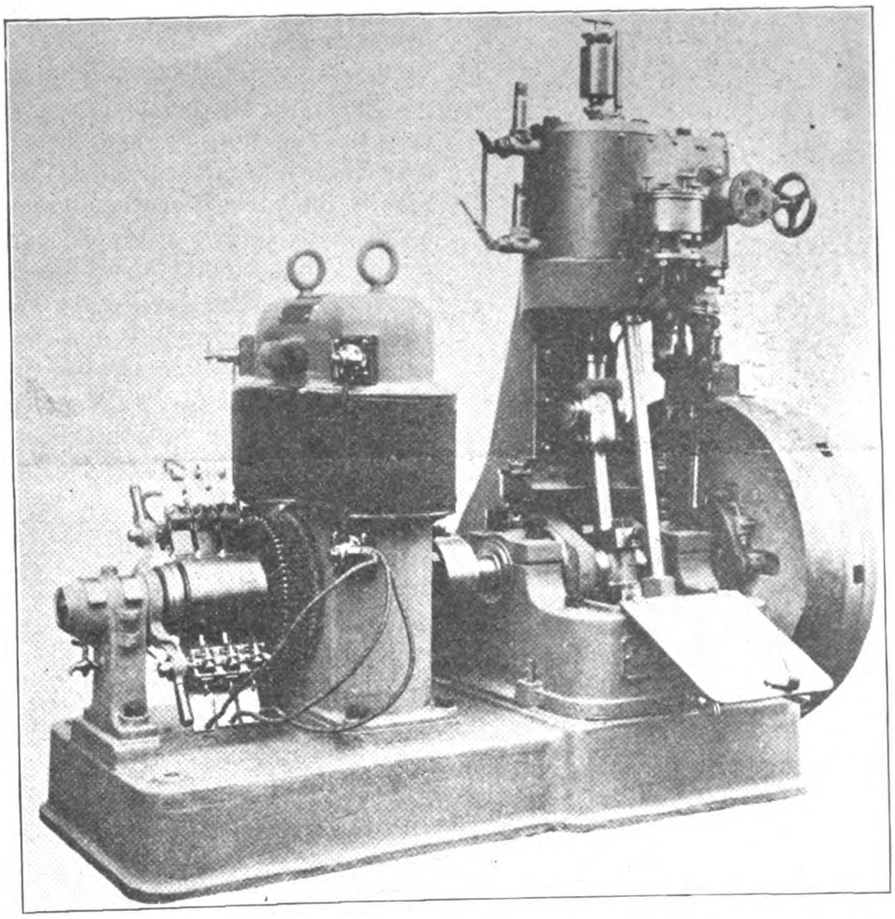


Fig. 5.—English Searchlight Generating Plant.

A combined gasoline engine or oil engine and electrical generator of English construction of this type was recently supplied to the British War Office for use in India as a portable searchlight electrical plant. This unit consists of a 3½ hp. air-cooled Simms motor fitted with the Simms high tension magneto ignition directly coupled to a four-pole direct current electrical generator having an output of 20 amperes at 75 volts. The motor operates at a speed of 1,500 revolutions per minute and was equipped with a specially designed petroleum carburetor, the engine starting and running on ordinary kerosene oil.

The plant was tested by the War Office, a continuous run being made underload for six hours. The motor is air cooled by means of a small fan driven by a belt from the engine flywheel; this device is said to keep the engine perfectly cool under the most severe conditions.

The engine has a mechanically operated inlet valve and arc light magneto ignition with advance sparking. The cylinder measures 82 mm. in diameter and 82 mm. stroke ($3\frac{7}{32}$ inches). The weight of the motor alone is but 65 lbs., its width being 6¼ inches, its length 11¼ inches and height overall 20¼ inches. This electrical plant is said to be capable of operating a novel searchlight continuously without overheating or giving any trouble whatever.

Some most interesting searchlight plants, consisting of steam engines of both simple and compound type with multipolar electrical generator, have recently been constructed at Slikkerveer, Holland, by the Electrotechnische Industrie, formerly Willem Smit & Co. The outfit (see Fig. 7) consists of a specially light high pressure steam dynamo for torpedo boats. The engine and generator combined have a total weight of 1,200 lbs., the capacity of the dynamo being 65 amperes and 80 volts, the engine speed is 550 revolutions per minute. This equipment was designed for use in the Dutch Navy. The steam dynamo, Fig. 8, was also constructed at Slikkerveer with splash guards, the multipolar direct current generator directly coupled to the engine and mounted on the same base being utilized for ship lighting, while the Dutch searchlight plant, Fig. 9, was constructed at the same place and has the splash guards removed so as to obtain a

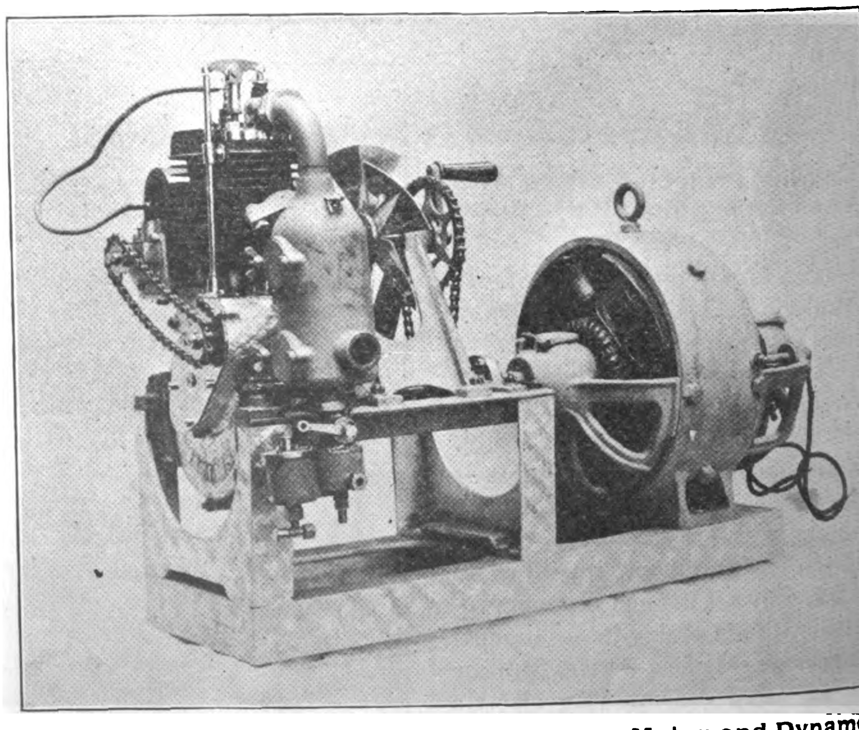


Fig. 6.—British War Office's 3 1-2 hp. Simms Motor and Dynamo.

better view of the details of construction of the engine. The engine of this unit is of the compound vertical type and operates at a speed of 325 revolutions per minute. The generator supplies a current of 400 amperes at a pressure of 65 volts and has an American enamel rheostat mounted upon the frame of the machine.

THE STORAGE BATTERY AS APPLIED TO ELECTRIC RAILWAYS.*

BY W. E. WINSHIP.

(*Concluded from page 106.*)

It is obvious that the voltage at different points could be maintained by copper, but the amount of copper would often be excessive. It is of great importance to maintain the voltage on the line at as high a value as is possible, for several reasons. It is the characteristic of series motors, such as are used in railway work, to take a definite current on definite grades outside of periods of acceleration and independent of the speed of a car. The speed will vary very approximately as the applied voltage; it is obvious, then, that to maintain a given schedule less cars will be required with high than with low voltage. Again, with cars on a grade or accelerating, the periods of taking excessive currents are of shorter duration with the higher voltage. The heating of the motors will depend largely on the time that these heavy currents are demanded, and as a result the motors will deteriorate and burn out very rapidly if the line voltage is too low. This item of motor repairs is a very serious one in electric railway operation. Again, the loss in transmission with low voltage is excessive. Taking into account the schedule speed and the transmission losses, the energy consumption will be approximately inversely as the squares of the applied voltages.

If the amount of copper is sufficient to furnish the average demands of the cars with a relatively small drop, when the cars are accelerating or mounting grades distant from the power house, especially when the service is supplied by only a few cars, the drop becomes excessive, and is felt all over the line. If a battery be installed at a point about three-fourths of the distance from the power house (which point would be modified somewhat by the location of grades), whose voltage is equal to the voltage which would exist at this point if all the cars were taking the average current, then it would charge on light loads and discharge when the load becomes heavy. This results in a very considerable equalization of load on the power house and in the maintenance of the voltage at the battery location at approximately a constant value, varying only 5 per cent. to 7 per cent. above and below the average. The battery will then neither experience a net charge nor discharge. Such batteries have been installed by putting in the number of cells corresponding to the average voltage before the erection of the battery. It is easily seen that the two values, voltage at this point with the cars taking the average current, and the average voltage, may be quite different, as the battery will modify the latter quite considerably.

An objection sometimes brought against such an installation is that it has no flexibility. It is, of course, absolutely determined by the feeder scheme and the service on the line. If the latter is increased, the battery will experience a net discharge. But this may be taken care of as follows: A certain number of cells may be cut out of service, corresponding to the increased drop; or if the schedule varies with the time of day, the battery may be installed so that it receives a net charge during the lighter service and furnishes a net discharge when the greater number of cars are run, or the voltage of the power house may be correspondingly varied. Sometimes the conditions would be met by a combination of these methods.

A small installation at Berlin, N. H., will illustrate what may be accomplished in this way. The road runs from Gorham to Berlin Mills, and is approximately 8½ miles long. The power house is .75 miles distant from the Gorham end of the line; from Gorham to Berlin there are numerous 3 to 5 per cent. grades, with one short, heavy grade of about 12 per cent. near Berlin; toward Berlin Mills there are several 8 per cent. grades. The track is 60-pound rail; bonding in poor condition. The line consists of one No. 00 trolley, with a 400,000 C. M. feeder to within 1 mile of the end; from Gorham to the power house there is a 400,000 C. M. copper return. A battery was installed in the car barn 6.5 miles distant from Gorham, consisting of 230 cells, having a capacity of 280 amperes for 1 hour. Ordinarily two 16-ton cars are operated under 40-minute headway. If extra cars are run for a short time, no change is made in the battery, If, however, it is desired to operate a 20-minute schedule over eight or nine hours, 30 of these cells are cut out, and the battery furnishes a net discharge of about 40 amperes. Before the battery was installed,

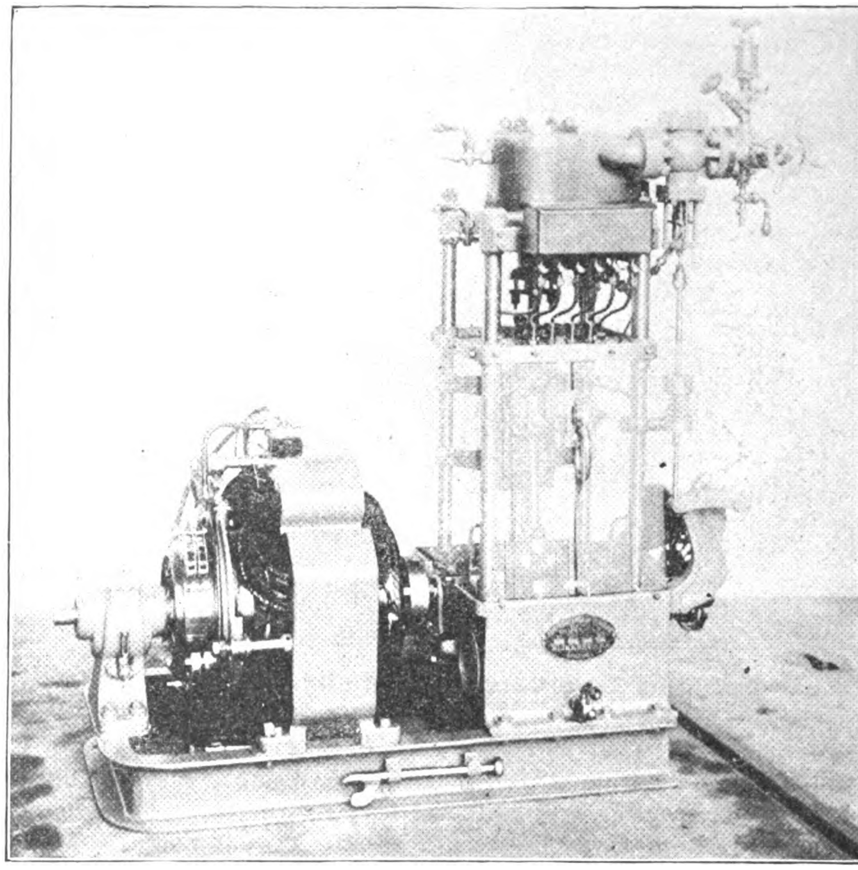


Fig. 7.—Dutch Navy Torpedo Boat Electric Plant (Page 115).

*From the "Journal" of the Franklin Institute, August, 1904.

it was impossible to operate more than the two regular cars. They are now able to operate four cars for eight to ten hours, and at times six cars are run.

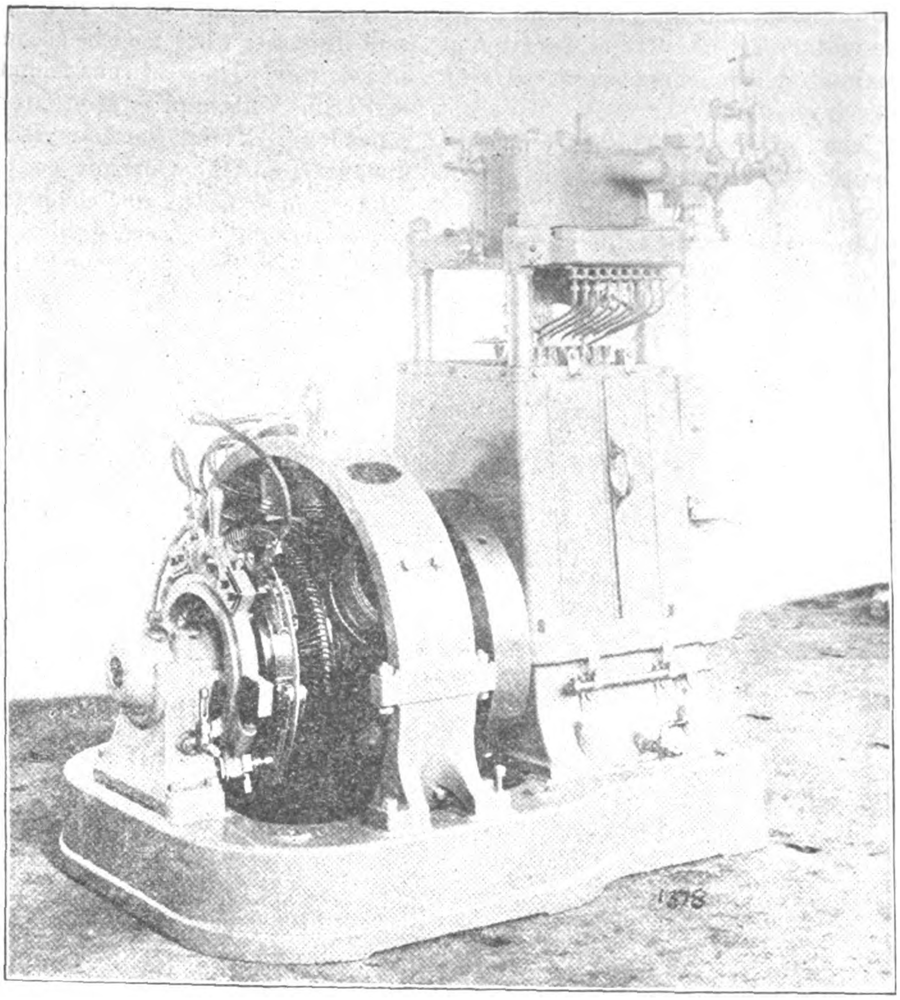


Fig. 8.—Searchlight Generating Plant at Slikkerveer, Holland (Page 115).

What promises to be an exceedingly useful application of floating batteries on interurban roads operating sub-stations at not too infrequent intervals is the installation of batteries in such sub-stations ordinarily to accomplish load equalization; in case of a breakdown of the sub-station of short duration, the battery would be placed directly across the line and allowed to discharge. If the breakdown is of long duration, a certain number of cells could be cut out and the battery "floated" between the two stations on either side to maintain the line voltage indefinitely at a value sufficient for continuous operation.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

A WATER RHEOSTAT USED AS A STARTING BOX.

A water rheostat may be used as a starting box in case of an emergency where it is necessary to start a motor when a starting box is not at hand, or in case of a starting box burning out.

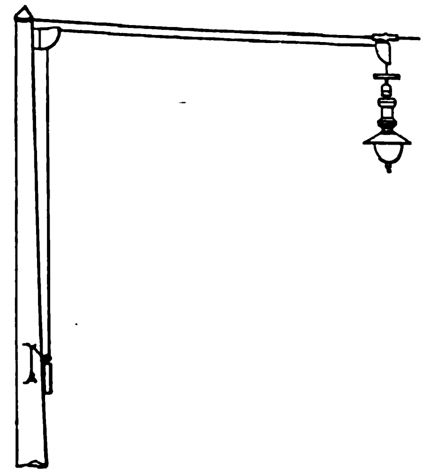
Take a wire from one side of the line and connect to motor as with an ordinary starting box. Then, take a wire from the other side of the line and connect to the field connection on the motor. Next, take a wire from the same side of the line as the field connection and connect to an iron or copper plate in a pail of water. Connect a wire to the armature side of the motor, then connect the other side of the wire to another plate, and the motor is ready to start.

To start the motor, place one of the plates in the pail of water; lower the other plate in the water until the motor is up to speed, then put the plates together so as to cut out all of the resistance. It is advisable to use a little salt in the water.

W. J. Hugo, Madison, Wis.

METHOD ADOPTED FOR KEEPING ROPES TIGHT IN CONNECTION WITH CROSS-SUSPENSIONS FOR ARC LAMPS.

The accompanying diagram shows the method adopted for keeping ropes always tight in connection with cross-suspensions for arc lamps where the weight of the lamp is borne by an automatic pulley and hook knob. The practice of having lamps swinging on the rope is dangerous, and, on the other hand, automatic suspension pulleys leave the rope alternately too tight and very slack in wet and dry weather respectively. The method shown herewith has been found very satisfac-



tory, not only for the reason noted above, but also because the rope does not have to come within 10 or 12 feet of the ground, so that unauthorized persons can not readily lower the lamp out of the supporting pulley, as had previously been of common occurrence, and because the weight very materially assists the lamp trimmer by partially balancing the weight of the lamp.

The trimmer uses a pole provided with a hook to catch into the ring at the end of the rope.

S. R. Inch, Missoula, Mont.

A SPECIAL TRANSFORMER USED FOR THAWING FROZEN WATER PIPES.

We have been doing a rushing business in thawing out frozen water pipes, and up to the present time we have not used over 6 kw. of current on any of the jobs.

The transformer we are using is a 5 kw., which is wound for 100–200 volts primary and 24 volts secondary; but the secondary voltage can be raised to 48 by connecting up in multiple across the 200 volts. The reason we use a transformer of this capacity and voltage is that 5 kw. is our standard size of transformer on incandescent distribution, which is all three-wire, 100 or 200 volts secondary, and there are places where the drop between transformers will throw the load almost entirely on one transformer.

The outfit is all put on a light wagon, and includes the special transformer, a regular 5 kw. transformer, used where primaries are nearer than secondaries, 400 feet of 00 flexible waterproof conductor, 1,000 feet of No. 6 waterproof wire for primary connections, and the usual switches and cutouts.

We do not use a water rheostat but ad-

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston Mass., May 24-27, 1904.

just the voltage by changing the connections to the length of pipe to be thawed, and we get the water running in about 20 minutes on the average. The shortest time thus far has been three minutes and the longest time two hours. We could work faster, of course, if we used a larger outfit, but what we have is inexpensive and economical and does not require any special care in handling.

H. A. Fee, Adrian, Mich.

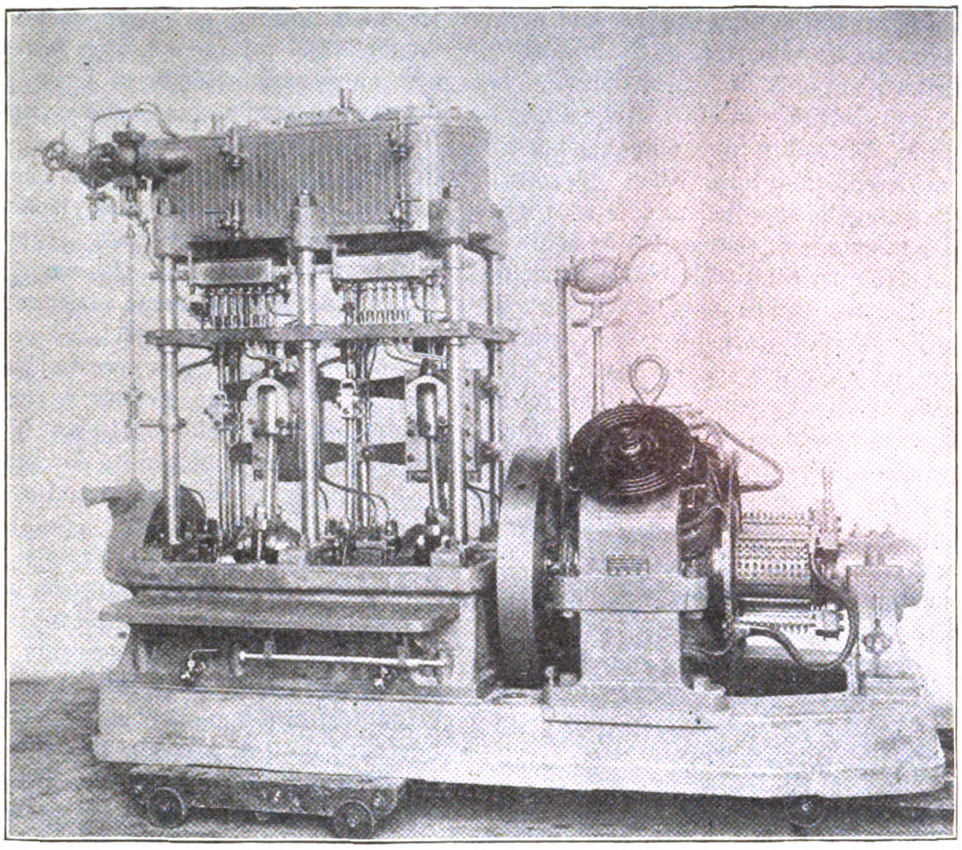


Fig. 9.—Dutch Ship Lighting Plant (Page 115).

A WRINKLE FOR THAWING WATER PIPES BY ELECTRICITY.

The recent severe winter has made the wrinkle I am about to describe of great value to our company, as well as a source of considerable "easy money." The writer, in his work, finds that there is a good profit in the price charged for such service—$10—and that all who get the service are glad to pay that price rather than wait until nature does the work or have the frozen ground dug up along the whole line of pipe.

We have used mostly direct current of 550 volts, although alternating current might be used to better advantage—provided a transformer of adequate capacity be available—for the reason that it is the ampere factor of the electrical energy imparted that does the heating, and by reducing the voltage to the lowest degree possible on the transformer connections, a greater amperage—consequently greater efficiency—is secured per kilowatt of power.

The idea is, briefly, the insertion of the frozen pipe in an electrical circuit, with an ammeter to tell the flow of current and a water rheostat to regulate same. As the electrical formula for heat generated in a conductor is, heat = square of current × resistance, and as resistance of both wrought-iron pipe and inclosed body of ice is high, this, together with a fairly large flow of current—at least 200 amperes—will develop a large amount of heat.

I note in issues of the *Scientific American* of March 5 and 19, in experiments conducted by Mr. E. B. Greene, of Altoona, Pa., and Mr. T. D. Bunce, of New York City, the following results:

Mr. Greene, using alternating current, with 50 volts on secondary wires:

Pipe length.	Diameter.	Time.	Kilowatts.	Amperes.
250 ft.	1 in.	20 min.	18–20	360–400
40 ft.	.75 in.	5-8 min.	11–15	220–300

Mr. Bunce, using 48 200-ampere-hour storage battery cells and regulating both voltage and amperage by various series multiple connections:

Pipe length. Feet.	Diameter.	Time. Min.	Kilowatts.	Volts.	Amperes.
70	0.5 in.	15	4.5–5	16	300
20	2 in.	3	10–12	6	2,000

Experimenting further, Mr. Bunce found that on connecting terminals of a 4-volt battery circuit, 185 amperes flowing, to 20 feet of $\frac{3}{4}$ inch pipe, drop at terminals was $1\frac{1}{2}$ volts, and at end of ten minute run, water rose from 39 to 41 degrees Fahrenheit, while pipe was not uncomfortably hot. On connecting up another cell, however, adding 2 volts, and raising amperage to 260, the result at end of ten minute run was that temperature of water was raised to 59 degrees Fahrenheit and the pipe was uncomfortably hot.

So much for the general idea; now for the specific application. The connections made by this company, if on a 550 volt circuit, direct current, were: Tap made from positive wire to a floor stand or single-pole knife switch; from other side of switch to some wedge-shaped piece of iron or copper (we used an axe), which is immersed in the water of the rheostat. A wedge-shaped metal is preferable, for the reason that if it should be necessary to break the circuit at the rheostat, it will be easier and the current will generally flow off better. For the water-resistance box we used an ordinary washtub made of wood and holding perhaps seven or eight pailfuls, and if flow of current was not sufficient when terminals of rheostat were as close as they could be safely brought, we introduced a quantity of salt to increase the conductivity of the water. For the other terminal of the rheostat we used a copper or iron plate, and this terminal was made fast to the end of frozen pipe, with an ammeter introduced between terminal and pipe. Then connection was made from a nearby hydrant, spigot in neighboring house, or to water main itself, and from there to return conductor. On closing circuit at switch and adjusting movable wedge of rheostat until desired current is flowing, the circuit is from positive wire to switch, to rheostat, to ammeter, to end of pipe, through pipe to water main, to hydrant, to return conductor. If alternating current is used with transformer, put rheostat on primary side, as thereby a smaller volume of water may be used.

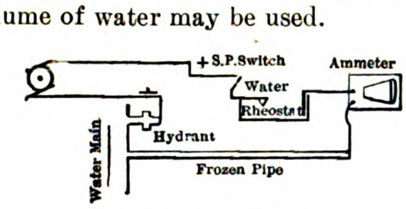


Diagram of Circuit.

Of course, the element of time is an important factor in this work, as often a smaller current will do the work in a longer time than the examples given above. It is also, of course, difficult to determine the exact distance the pipe is

frozen. In a recent case we had a current of 190 amperes flowing for 15 minutes and got a full flow of water at that time, where pipe circuit was over 100 feet of ¾ inch pipe.

EDWARD S. GOLDTHWAITE,
Suffield, Conn.

—

ELECTRIC FANS FOR KEEPING WINDOWS FREE FROM FROST.

During sudden changes of temperature, when much moisture is in the air, a great deal of trouble may be experienced by merchants in their display windows on account of the frost forming on the glass and thus hiding the window display. The frost may be easily removed by directing the blast of an electric fan against the window, which will clear away the frost and keep it away, besides pleasing the consumer and adding a long-hour user to the company's list of patrons.

L. BEMIS, St. Paul, Minn.

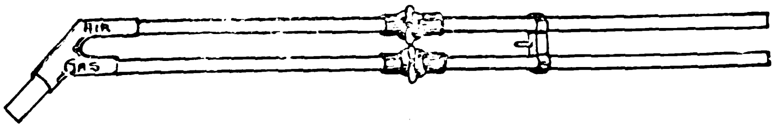
—

A HANDY TOOL FOR THE DYNAMO ROOM.

Very often a great deal of difficulty is experienced in removing a pulley from a shaft after the pulley has been on the shaft for any length of time, and pulling and pounding and forcing will only batter up the shaft and pulley, without accomplishing anything further.

Where gas is piped into the dynamo room, a bunsen burner made up of half-inch gas pipe, connected up by a flexible tube to the gas supply and to an air compressor, or some means of supplying air under a slight pressure, will be found very effective in removing a pulley that sticks, as an intense heat can be applied to the hub just where it is wanted by means of the bunsen, and the hub heating up rapidly expands before the heat is conducted to the shaft, which allows the pulley to be easily removed without any dangerous pounding or straining.

T. CRAWFORD, Dallas, Tex.



HANDY TOOL FOR THE DYNAMO ROOM.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 103.*)

Light of Incandescent Lamps.—The importance of considering in its proper aspect the light of lamps of the incandescent type, is due to the relationship between voltage and candle power in these lamps. To obtain the maximum light from the minimum power is not so much an object as to obtain durability or lasting qualities in the lamp. As lamps grow old they deteriorate and the light grows dim, so that to obtain the correct candle power such an accession of power is required as to make the production of such light a most uneconomical proceeding. The efficiency of a lamp, or the relation between the light it gives and power it consumes, are matters of the utmost importance not only in its construction but in its utilization as well. In speaking of power, both volts and amperes must be considered, therefore, when greater or less voltage is supplied to lamps or when the percentage of the normal is below or above 100 per cent., the power consumption and the candle power vary accordingly. Tables have been prepared by many manufacturers covering these features, but they generally relate to the ratio of candle power to watts. This is given in the form of a given number of watts per candle power, and the average lamp consumes from between 3 to 4 watts per candle power. In the following table some figures are given expressing the relationship between light and power for a consumption of power which varies from 1 to 4 watts per cp.:

TOTAL WATTS = 64.

Watts per cp.	Total cp.
1.0	64.00
1.5	42.66
2.0	32.00
2.5	25.60
3.0	21.33
3.5	18.29
4.0	16.00

The practical basis is about 3.1 to 3.5 watts per candle power and on this relationship of power to light the following lamps, their candle power and wattage are given:

WATTS PER CP. = 3.1.

Candle power.	Total watts.
100	310
50	155
32	99.2
16	49.6
8	24.8

These figures are bound to vary after the lamps have been in use a certain number of days. After prolonged use the lamps appear smoky and give a poor and inefficient light, which is due to the increased resistance of the filament. But if more than the normal pressure is supplied the light though brilliant is in the end very expensive because of the subsequently rapid injury to the lamp and its exceedingly poor return for the power. The normal voltage of a lamp therefore changes; gradually rising as the life of a lamp goes on and thereby increases the watts per candle power and drops the efficiency lower. A lamp lasts much longer if the voltage is a little lower, and acts more satisfactorily as a light producer in the end as far as the expense for lamps is concerned. But the danger lies in the voltage being too low and the light too dim. Then the practical efficiency of the lighting plant is affected. If the drop in the wires cause this, the wiring is a failure, but if the dynamo pressure is too low it should be increased. As an illustration of the enormous practical importance of this fact in electric wiring and electric lighting, take a 110-volt lamp of 16 cp. and run it below its normal pressure. Let the voltage be limited to about 104.5 to 105.5 volts and measure the candle power. It will not exceed 12 cp. In other words, a slight reduction in voltage to the lamp means a great drop in candle power, and if ten or twenty thousand dollars are spent to obtain a certain amount of candle power and 25 per cent. is wasted by low pressure the remaining candle power is obtained at a heavy expense. The only item to counterbalance this is the saving in lamp cost. The saving in lamps must therefore be balanced up against the value of the lost light on such a basis. In all probability a 25 per cent. cut in candle power will not pay when compared with the cost of lamp renewals. Take a 1,000 light 110 volt plant at an estimated cost of $10,000. If 25 per cent. of the light is wasted in order to save lamp renewals then the light of 250 lamps, at a pressure of about 106 volts, is practically thrown away. The cost of 1,000 lamps is about $200 at 20 cents apiece, or higher, as the case may be according to prevailing market rates. The value of the light of 250 lamps, if supplied outside, is at least $100 a month. Estimating the life of these lamps at 600 hours and burning them 5 hours a day, it would mean 130 days or about a four months' steady run before they completely failed. If run at a low voltage they might last longer and only mean renewals twice, instead three times a year. The cost of this is about $400, which can be compared with the $1,200 worth of light thrown away by low voltage. If the *coal pile alone* is considered, it will be seen that the amount of coal required for 1,000 lights at 5 lbs. per horse power

hour would be, on the basis of 12 lamps per horse power, as follows:

If 12 lamps = 5 lbs. per hour, then 1,000 lamps = 83 × 5 = 415 lbs. per hour.

On the estimate of 5 hours' lighting a day the total weight of coal consumed amounts to 5 × 415 = 2,075 lbs. or about one ton. This coal may cost various prices per ton, but if $4 is taken as a fair price for good coal, then the expense in this direction amounts to about $1,200 for 300 working days in the year. Of this amount 25 per cent. or $300 worth is systematically thrown away by the low voltage being employed to save lamp wear. Each lamp renewal costs $200, and it seems at the best all that can be done is to reduce the number of lamp renewals from three to two per annum. This means a saving of only $200 in lamps as compared with $300 worth of coal which is burned and wasted. The depreciation of the plant is not considered nor the interest on the investment, nor the fact that the labor paid for each year could do the extra lighting without extra trouble, etc. Another feature of the case is the fact that if the light is poor extra lighting must be done to supply the required illumination, as the practical basis for ordinary rooms should be about 16 cp. for every 50 or 75 square feet of floor space, depending upon the tone of the decorations and wall paper. The appended table, giving figures taken from the records of the largest manufacturers of lamps in the United States with additions by the author, shows the fall of efficiency with the voltage and the heavy reduction in the illuminating power of the lamp:

RATE OF 3.1 WATTS PER CP.

Percentage of the correct lamp pressure.	Percentage of the correct candle power.	Watts consumed per cp.	Candle power of a 100 cp. lamp.
90	53	4.68	53
91	57	4.46	57
92	61	4.26	61
93	65	4.1	65
94	69.5	3.92	69.5
95	74	3.76	74
96	79	3.6	79
97	84	3.45	84
98	89	3.34	89
99	94.5	3.22	94.5
100	100	3.1	100
101	106	2.99	106
102	112	2.9	112
103	118	2.8	118
104	124.5	2.7	124.5
105	131.5	2.62	131.5
106	138.5	2.54	138.5

The figures show that in the case of a 100 cp. 110 volt incandescent lamp between the voltages of 99 and 116.6 the candle power varies from 53 to 138.5 or almost as 1 is to 3.

The various types or shades and globes also govern the amount of effective candle power obtained. It is a well-known physical fact that the various colors of glass are more or less absorbtive, and may reduce the amount of useful light to such a degree as to render useless efforts to better it. The following figures relate to this fact with respect to the globes and the degree of absorption:

Character of glass.	Percentage of wasted light.
Ordinary pane glass...	about 10 per cent.
Cut or pressed glass..	from 10 to 15 "
Ground glass........	" 25 to 40 "
Opalescent glass.....	" 25 to 50 "
Red glass...........	" 30 to 60 "
Blue glass...........	" 15 to 30 "

The depth of color in the glass is a prime factor in determining the degree of absorption. A great deal of candle power can be produced, and wasted by the the use of poor globes, thus nullifying advantages of good wiring and regulation.

Choosing Globes.—In choosing globes several points must be taken into consideration which might be tabulated in the following manner:

1—Cost of globes.
2—Diffusion of light.
3—Degree of absorption.
4—Artistic design.
5—Fragility.

By the use of a little common sense the selection of such important articles can be made with a definite purpose in view. Many of the best looking globes are poor light transmitters and the converse. As a general rule the cost and design are the predominating factors, whereas the effective diffusion of the light and the degree of absorption are perhaps of more importance from an economical and practical standpoint in the long run.

The area of the lighted room as well as the height of the ceilings next lead to the determination of the answer to the question: "How shall the lamps be distributed and how many must be used?" Take a room 20 feet in length by 15 feet in width and 12 feet high. The floor area is 20 × 15 = 300 square feet and the wall area equals 15 × 12 × 2 = 360 added to 20 × 12 × 2 = 480 or a total of 840 square feet. In order to illuminate this room succesfully side lights must be employed and a chandelier. Allowing one 16 cp. lamp for every 50 square feet, in the case of a parlor or drawing room a six-light chandelier is required. If side lights exclusively are employed the figures used with reference to the walls would be 100 square feet per 16 cp. lamp or an allowance of about 8 lamps. When the lighting is divided up between the side lights and chandelier about four side lights and four chandelier lights are the best to employ. This would mean the utilization of about 100 cp. from the chandelier after it passes through the globes and 130 cp. from the side lights if used exclusively; or a total amount of candle power equal to at least 130 if distributed throughout the room. It is therefore evident that the *distribution* of the light is of more importance than the quantity, and a great deal of power can be ineffectively used to light a room where one-half as much, consumed in properly arranged lights, would give greater satisfaction. The absorptive power of the globes must be considered in practical lighting particularly where it is necessary to bring out decorative effects at night.

If the general tone produced by the decorators' art in fine apartments is blue, pink or red, the lighting must be done by choosing positions and globes to augment this effect and not to produce a disagreeable impression through inattention to such details. If red, blue or other colored globes are employed and full illumination is required the lost percentage of light must be added in the number of lamps or the candle power of the globes.

It is well for those desirous of making of wiring an art as well as a trade to study the requirements of the business and social world in order to succeed in meeting the demands they make upon the contractor. The great dry-goods and department stores, the public buildings, the theaters, the churches and the home—these are not easy problems that relate alone to the putting in of wires. They call for greater knowledge, which in its highest form goes hand and hand with the dictates of art and fashion. To produce not merely light, but a uniform light is the main idea, and in great auditoriums a careful study of conditions is the only way of meeting with any degree of success. The candle power is dependent entirely upon the voltage and to keep this up to the standard as well as to control the groups of lights, or, in other words, to obtain *control* and *regulation* of the light with one or more dynamos in lighting plants, the switchboard has been universally adopted.

Switchboards.—As the switchboard represents the connections which are made to obtain convenient control of the circuits and in the case of several generators to

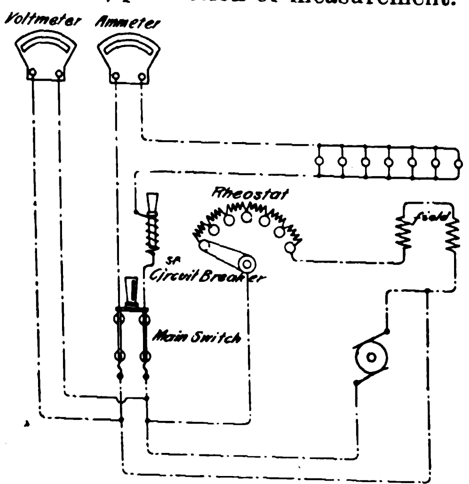
effectually combine and direct their output, they are supplied with switches, measuring instruments, circuit-protecting devices and regulating devices. These may be considered in their order—

1—Switches,
2—Meters,
3—Circuit-breakers,
4—Rheostats,

further additions being merely secondary accessories not required by the code.

A switchboard cannot be designed until the circuits leading to and from it have been carefully drawn out so that the number of switches, meters, circuit-breakers and rheostats are fully known. It is not the practice to put up a board and then attach the wires, because the stony character of the material calls for careful drilling, and in addition, the size of the stone or marble slab must be determined from the apparatus to be attached to it. This can be obtained from the schedule or list of the circuits and the character of the generators to be connected.

Connections of a Shunt Wound Generator.—The essential connections of a shunt wound generator relate to the armature and field connections and the devices connected to them either for purposes of regulation, protection or measurement.



Connections and Accessories of a Shunt Wound Dynamo.

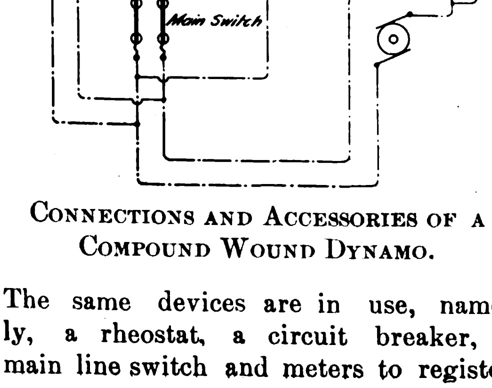
As shown in the illustration the connection of a shunt wound generator call for a rheostat in series with the field circuit; a main switch which controls the entire current supply and the two essential measuring instruments, an ammeter and a voltmeter. The ammeter is in series with the main circuit and indicates the total flow of current. The voltmeter is in multiple with the main circuit and indicates the voltage at the switchboard.

Protection.—The circuits are protected individually by means of fuses and collectively by means of a circuit-breaker. There is a main switch, which, when opened, cuts off all communication between the dynamo and lighting circuits. This is also fused and acts as a protective device, but the device which is accepted as most reliable and convenient is the automatic electro-magnetic circuit-breaker.

Circuit Breaker.—An automatic circuit breaker consists of a helix of heavy copper wire through which the full volume of the current circulates. This helix attracts an iron core whose pull is resisted by a powerful spring. The magnetic pull and the spring balance each other under ordinary conditions. When a heavy short circuit occurs, the pull of the helix, and consequently of its core, becomes so great that the spring is overcome and a latch opens allowing the main line switch to fly open. This switch is so constructed that it opens instantaneously and without arcing and acts as the most efficient circuit protector in daily practice.

Rheostat.—The rheostat is in series with the field winding and the main line is tapped at both poles to supply it with current. An examination of the sketch will show that the field and rheostat in series, are together in multiple with the armature terminals, so that the regulation of the dynamo can be readily accomplished by following the connections and mounting the rheostat on the switchboard. The rheostats in general use for switchboard connection are of the enamel type, that is, composed of iron or composition wires buried in enamel and attached to a flat metallic frame with considerable radiating surface. They occupy little space and have added greatly to the equipment of the switchboard.

Connections of a Compound Wound Generator.—The sketch shows a difference between the connections only in so far as the series winding is concerned,



Connections and Accessories of a Compound Wound Dynamo.

The same devices are in use, namely, a rheostat, a circuit breaker, a main line switch and meters to register current and voltage. The series winding also carries the total current of the lamps, and final connections must be made to this effect. On nearly all switchboards there is provided a pilot lamp, which gives the light or pressure straight from the dynamo, and in addition a ground detector which is merely a lamp with one leg grounded and a push button in circuit to show the presence of a ground. It is so constructed that both legs of the circuit can be tested. The switchboard of both machines can be so designed that the street service can be turned on by use of a double poled and double throw switch. The compound wound generator is almost exclusively employed in private plants and for street railway work on account of its automatic regulation.

Fuses.—The fuses in general use for switchboards are of the approved non-arcing type. Fuses of this character are surrounded by an envelope or tube of incombustible material, within which the melting or volatilization of the fuse may take place without the spattering of metal or the deposition of fumes on the polished switchboard. In total these items comprise the essentials and accessories of an ordinary switchboard for a single shunt or single compound wound machine.

THE INTERNATIONAL ELECTRICAL CONGRESS.

The latest bulletin issued in regard to the International Electrical Congress states that 1,500 members have been accepted and that 80 papers are already in type.

The Italian visitors, who arrived here last week, have enjoyed a series of pleasant excursions in and around New York, a visit to the Edison Laboratory, the Crocker-Wheeler factory, and a banquet at the Hotel Savoy.

The committee of the American Institute of Electrical Engineers, of which Mr. J. W. Lieb, Jr., is chairman, will proceed to Boston to-morrow, accompanied by the Italian delegates, to welcome the party of about 100 members of the British Institution of Electrical Engineers who will land in that city.

After a reception in Boston, which will be on an elaborate scale, the foreign visitors will start for New York, arriving here on Sunday morning.

The New York reception committee of the Institute has made arrangements to transfer the guests from the boat, on Sunday morning, direct to their hotels. Sunday morning will be left free for rest and recreation, church attendance, inspection of the city, etc., and guests and par-

ticipating members of the Institute are invited to visit and register at the official Institute and committee headquarters, suite No. 116-117, first floor, Waldorf-Astoria. At the headquarters necessary tickets and badges will be distributed and all information given by the secretaries and committee in charge.

On Sunday afternoon, September 4, by invitation of Mr. J. G. White, member of the committee, a special trip will be given by steamer Richmond of the Starin Transportation Line, to view the scenery of the Hudson River. Mr. White and the committee are desirous that as many members of the Institute (with ladies) as possible shall participate in this trip and assist in extending hospitalities to the friends from abroad. The steamer will await the party at the foot of West 35th street, Hudson River, and all intending to go should be aboard not later than 1:45, as start will be made promptly at 2 P. M. The trip up the Hudson will extend as far as tide and weather permit, and buffet luncheon will be served immediately after the boat leaves the dock. The return trip will include the famous Lower Bay of New York and part of the course of the International Yacht Races. Believing that all the visitors would like to see the unique electric lighting effects at Coney Island, Mr. White has arranged to extend the trip to that point, the steamer to dock at one of the piers near "Dreamland." It is proposed to start on the homeward trip to New York sharply at 9:30 P. M., insuring an arrival in good season at the West 35th street pier.

On Monday (Labor Day), September 5, visitors and all members of the Institute desiring to participate are invited to inspect the new subway. The party will assemble at 9:15 A.M. sharp on the steps of the City Hall, in order to take special train furnished courteously by the Interborough Rapid Transit Company, starting from the City Hall station at 9:30 A.M. This train will run up the west side subway to the 59th street and Columbus Circle station, at which the party will disembark to proceed to the new 59th street power house of the Interborough Company. At 11 A.M. a special steamer of the Long Island Railroad Company will be boarded at the 58th street pier of the Interborough Company and the party will then proceed up the Hudson River to the Kingsbridge power plant of the New York Central Railway Company. The New York Central & Hudson River Railroad Company and the Western Union Telegraph Company have also placed large tugs at the disposal of the committee for transportation purposes, and Mr. Charles G. Curtis has loaned the committee the turbine yacht Revolution, to accompany the excursion, so that guests can inspect her operation en route. The party will pass by the Ship Canal to the Harlem River, and at 12:30 P. M., will leave the Kingsbridge plant for the 96th street power house of the New York City Railway Company. At 2 P. M. the party will leave 96th street for the 74th street, or Manhattan Elevated plant of the Interborough Company, on the East River, and at 3 P. M. will leave that point for the 38th street station of the New York Edison Company. After visiting this center of generation and distribution of current for light and power all over Manhattan Island, the party will disband.

On the evening of Monday, September 5, the American Institute of Electrical Engineers, with the co-operation of the New York Reception Committee, will give a banquet to the Institution of Electrical Engineers, to the visiting officers and members of the Associazione Elettrotecnica Italiana and other friends from abroad, at the Waldorf-Astoria, at 7 P.M., in the grand ballroom, preceded by a reception in the Astor Gallery, at 6:30 P.M. In view of the fact that the special train for St. Louis leaves early next morning, the speaking will be limited and brief, and the affair will close at an hour not later than 11 P.M. The visitors from abroad will be the guests of the Institute and the committee.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 23, 1904

Electric Railways and Appliances.

768,040. Car-Fender. George H. Fraser, Brooklyn, N. Y., and James N. Welkly, Jersey City, N. J.; said Welkly assignor to said Fraser. Filed Dec. 31, 1897.

768,121. Self-Oiling Trolley. Frederick Hackmann, St. Paul, Minn., assignor of thirty thirty-seconds to Frank L. Gazzolo, John R. Patty, Thomas Billingsley, Stuart B. Shotwell, Otto Muller and Charles Brenck, same place. Filed Oct. 15, 1903.

768,176 Car-Fender. Sylvester S. Hawley, Odin, Ill., assignor of one-half to William Denman, Centralia, Ill. Filed May 21, 1904.

768,245. Trolley. Francis C. Sullivan, McKeesport, and Louis S. Harris, Pittsburg, Pa. Filed July 22, 1903.

768,260. Automatic Brake and Take-up Device for Trolley-Cords. Edward H. Amet, Waukegan, Ill. Filed June 6, 1904.

768,277. Fender for Cars or Other Vehicles. William L. Green, Waltham, Mass. Filed Jan. 26, 1904.

768,325. Trolley-Restorer. Edward L. Calahan, Clifton, N. J., assignor of one-half to William M. Perkins and George H. Souther, Brooklyn, N. Y. Filed Nov. 6, 1903.

768,357. Electric Track-Brake. Fred B. Corey, Schenectady, N.Y., assignor to the General Electric Company. Filed Sept. 27, 1902.

768,502. Automatic Train Signaling and Recording System. Frank R. Wood and Daniel F. Shamberger, Sparrows Point, Md. Filed Aug. 24, 1903.

Electric Lights and Appliances

768,479. Incandescent Electric Lamp. Dennis J. O'Brien, San Francisco, Cal., assignor, by direct and mesne assignments, to the O'Brien Reflector & Electric Tube Lamp Company, same place. Filed May 25, 1903.

Electrical Machinery and Apparatus.

768,036. Power-Transmitting Device. Isidor Deutsch, Montreal, Canada, assignor to the Electric Train Lighting Syndicate, same place. Filed Oct. 21, 1903.

768,114. Power-Transmitting Device. George R. Dean, Chicago, Ill. Filed Aug. 5, 1903.

768,214. Electric Switch and Circuit-Breaker. Charles E. Carpenter, New York City, assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed Jan. 16, 1904.

768,227. Electric Switch and Circuit-Breaker. Albert J. Horton, White Plains, N.Y., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis Filed Jan. 16, 1904.

768,240. Electrical Indicator. Lewis H. Sanford and George H. Sanford, Augusta, Me., assignors of one-half to William B. Taylor, St. Louis, Mo. Filed Nov. 10, 1903.

768,262. Controller. Harvey L. Bachman, South Bethlehem, Pa. Filed May 31, 1904.

768,288. Interrupter. Edwin W. Kelly, Philadelphia, Pa., assignor to the Roentgen Manufacturing Company, same place. Filed March 28, 1904.

768,332. Contact-Clamp for Carbon Rheostats. Carl W. Larson, Schenectady, N.Y., assignor to the General Electric Company. Filed Sept. 4, 1902.

768,334. Breaker for Electric Circuits. William J. Lloyd and Gilbert Wright, Pittsfield, Mass., assignors to the Stanley Electric Manufacturing Company. Filed July 8, 1902. Renewed Jan. 23, 1904.

768,337. Alternating-Current Motor. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 21, 1903.

768,343. Indicating Instrument. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 25, 1898.

768,344. Means for Controlling Electric Meters. William H. Pratt, Lynn, Mass., assignor to the General Electric Company. Filed Jan. 20, 1903.

Telephones and Telephone Apparatus

768,039. Telephone-Exchange Apparatus. James S. Ford, Chicago, Ill., assignor to the Western Electric Company. Filed April 9, 1902.

768,185. Telephone. John W. Kurtz, San Francisco, Cal. Filed Oct. 17, 1902.

768,272. Party-Line Telephone System. Thomas C. Drake, Malta, O. Filed Nov. 9, 1903.

768,541. Means for Intensifying Telephonographic Records. Elias E. Ries, New York City. Filed Nov. 3, 1903.

768,547. Telephone and Signal Apparatus for Railway-Trains. Benjamin W. Speck, Uhrichsville, O. Filed Feb. 11, 1904.

768,569. Telephone-Transmitter. Arthur J. Mundy, Boston, Mass., assignor to the Submarine Signal Company, Waterville, Me. Filed April 23, 1902.

Miscellaneous.

768,048. X-Ray-Tube Stand. George R. Hogan, Chicago, Ill., assignor to the McIntosh Battery & Optical Company. Filed Nov. 30, 1903.

768,054. Electric Furnace. Carl G. P. de Laval, Stockholm, Sweden. Filed May 8, 1903.

768,098. Thermostat. Charles L. Walker, Harrow, Eng. Filed July 31, 1903.

768,175. Connector for Electrochemical Apparatus. Oliver P. Fritchle, Denver, Col. Filed Dec. 28, 1903.

768,180. Galvanic Battery. Alex J. Jacobson, Hamburg, Germany. Filed March 19, 1903.

768,196. Lightning-Arrester. Charles A. Rolfe, Adrian, Mich., assignor to the Rolfe Electric Company, Chicago Ill. Original application filed April 21, 1902. Divided and this application filed Jan. 21, 1903.

768,199. Rheostat. Irving B. Smith, Philadelphia, Pa. Filed Dec. 9, 1903.

768,301 Wireless Electrical Signaling. Michael I. Pupin, New York City. Filed June 13, 1903.

768,372. Electric Battery. Pierre J. Kamperdyk, New York City. Filed Oct. 14, 1903.

768,421-511. Electric Striking Clock and Contact Device for Electric Clocks. Ragnar Carlstedt, Rallsa, and Bernhard Gustafson, Stockholm, Sweden. Filed Nov. 19, 1903.

768,545. Electric Conduit Box. Dennis Shea, Chicago, Ill. Filed Aug. 20, 1903.

768,558. Electrical Selecting or Individualizing Instrument. William S. Burnett, Milwaukee, Wis. Filed Aug. 26, 1901.

768,570-571-572-573. Sound Transmitter and Receiver and Submarine Sound-Direction Finder. Arthur J. Mundy, Boston, Mass., assignor to the Submarine Signal Company, Waterville, Me. Filed April 23, 1902.

THE TELEPHONE WORLD.

Bids Wanted for Telephone System.

Sealed proposals will be received until September 22, at the office of the United States Reclamation Service, Chamber of Commerce Building, Denver, Col., for the construction and completion of a telephone system about 28 miles in length, in connection with the Uncompahgre Valley reclamation project, near Montrose, Col. Specifications, blank forms of proposal and full particulars may be obtained by applying to A. L. Fellows, United States Geological Survey, Chamber of Commerce Building, Denver, Col., to the engineer of the United States Reclamation Service, Montrose, Col., or to the chief engineer of the United States Reclamation Service, Washington, D. C.

Farmers Organize Another Telephone Company.

The Washington Mutual Telephone Company was lately organized at Washington, Kan., with the following officers and directors: John King, G. Wertman, O.G. Lobaugh, A. H. McGregor, Ira Henry, J. E. Baker, D. A. Kramer. John King was elected president and O. G. Lobaugh secretary. This is an organization of farmers for their own benefit. They will incorporate and proceed at once to build their line.

A meeting of the stockholders of the Citizens' Standard Telephone Company was lately held at Kingston, N. Y. The following directors were elected: I. H. Griswold, S. B. Rawson, T. M. Brush, Elyria, O.; Howard Hendrickson, Albany; J. E. Klock, Mortimer C. Drake, James H. Everett, Kingston. The following officers were elected: President, Mortimer C. Drake; vice-president, J. E. Klock: secretary and treasurer, Charles Reynolds, Jr.; manager, William H. Short. The business of the company is in better condition than at any previous time in its history. New telephones numbering 150 have been installed in the past year, and the company intends to make many improvements to the service. A number of out-of-town stockholders were present at the meeting.

Alderman Andrews has estimated that a suitable municipal telephone exchange for Brantford, Ont., would cost $37,500. The expenses including everything, would, he said, be $9,000, and the receipts $10,000. Besides, a saving of $3,750 would be effected for present subscribers.

The new $50,000 Iowa Telephone Company Building at Muscatine, the third of the kind in the State, was recently opened to the public, and fully 1,000 people inspected it.

The number of farm telephone lines in Iowa is increasing with marvelous rapidity. Linn County is said to have the greatest number of farm companies. There are few rural districts in the State without telephone connection.

E. C. Willis, from Hazleton, Pa., has succeeded Harry M. Moorhead as superintendent for the Standard Telephone & Telegraph Company of Newtown in that State.

From Connellsville, Pa., news is received that the Tri-State Telephone Company lately began the construction of a line 2½ miles long from Dawson to Flatwoods.

No Municipal Telephone System for San Francisco.

Supervisor Braunhart takes exception to the proposal of the police and fire commissioners to acquire a municipal telephone system. He declares the matter lies entirely with the supervisors, who have no such intention in mind. He says the city has a 30-year agreement with the telephone company for a free telephone system in the city hall, which is worth $30,000 yearly to the city. The company has provided a new chief operator for the system, good service is now being given and there is no intention on the part of the supervisors to make a change.

To Use Telephones for Train Orders.

Announcement is made from Rochester, N. Y., by the officials of the Buffalo, Rochester & Pittsburg Railroad that telephones will soon replace the telegraph on the line and all its branches for the dispatching of trains and the carrying on of the business of the road.

It is the plan to discard altogether the telegraph. Economy is at the bottom of the change.

The Citizens' Telephone Company, of Grand Rapids, Mich., has purchased the West Michigan Telephone Company's property at Allegan. The Allegan exchange was owned by Major Cornwall and M. D. Owen and operated with 300 telephones in Allegan and vicinity. The Grand Rapids company intends stringing two copper circuits from that city to Allegan that better connection may be had in the new service, which has been acquired.

Frank L. Bills, of the Sioux City Telephone Company, says the work of connecting up the various Independent company lines of Northwestern Iowa and South Dakota is progressing rapidly. He lately had a long distance conference with some of the promoters of the Independent telephone business in Sioux Falls and Yankton, and received assurances that work on the lines in that part is being pushed ahead as rapidly as possible.

A new telephone line has recently been constructed by the Farmers' Telephone Company, extending from Endicott Wash., into the country about 10 miles. The majority of farmers along the route have placed 'phones in their houses.

A rural telephone line has just been completed in Healdsburg, Cal., connecting all the ranches nine miles north of that city and residents of Dry Creek Valley with the office in Healdsburg.

The Star Telephone Company has filed a certificate changing its office from Jersey City to Camden, N. J.

The Moorestown, N. J., township committee has refused to permit the Bell Telephone Company to string wires and lay conduits there.

The Lewisburg, O., Telephone Company has increased its capital stock from $10,000 to $20,000.

Prospects are bright for an opposition telephone company at Woodstown, N. J., to co-operate with a rural line connecting the farmers.

Telephone Cable to Connect Vancouver and Pacific Coast Cities.

Direct telephone communication between Vancouver, B. C., and the various cities along the Pacific coast is declared to be a certainty. Arrangements are practically completed for the installation, by the New Westminster and Burrard Inlet Telephone Company of Canada, and the International Telephone Company of Bellingham, of a telephone cable line to connect, on a direct wire, Bellingham and Vancouver. From Bellingham an exchange will connect, by means of the Pacific States Telephone Company, all the coast points.

The new cable will be installed at a cost of $6,000 a mile, and a total cost of $100,000. It will be constructed partially by American and partially by Canadian capital, and both the New Westminster and the International Companies are under practically the same management. The latter concern was incorporated under the laws of the State of Washington but a short time ago for the protection of American stockholders. The American end of the wire will be laid under the direction of the American concern.

The proposed route of the cable is from the eastern shore of Vancouver Island across San Juan, Orcas, Shaw and Lummi Islands. The connection at this end will be at Marietta, not far from Bellingham. The entire line will be some 65 miles in length. Fifty miles of this will be land, and the other 15 miles sea cable. It will be the most expensive telephone cable line in the United Stated when completed, so it is claimed. The average cost of laying such a line has heretofore been about 15 cents a foot.

It is stated that the cable will be of English make, and will consist of four big copper insulated wires, capable of withstanding an enormous strain.

Work on the Pittsburg, Pa., & Wheeling, W. Va., telephone line is being rushed. The contractors have lately been at Taylorstown, near Washington, Pa., where the Keeling & Ridge Company of Pittsburg, has about 100 men employed. All rights of way have been secured between Bridgeville and Washington to Wheeling. The new line will pass through Claysville, West Alexander and many smaller towns. It will cross Chartiers Township between Washington and Gretna, and likely will connect with Canonsburg and reach the Pittsburg & Allegheny either at Carnegie or Mt. Lebanon.

W. R. Doss, of Welch, W. Va., has secured a contract from the water department of Lynchburg, Va., to erect a telephone line 25 miles long to the site where it is proposed to secure water for the city. The contract amounts to about $3,000.

The Pennsylvania Telephone Company has completed a line between Hamburg and Kempton, covering a distance of 17 miles.

Telephone Incorporations.

The Monroe County Telephone Company. Dundee, Mich. Capital stock, $15,000.

The Hudson Prairie Telephone Company. Hudson, Wis. Capital stock, $3,000. Incorporators: George Turner, Arthur McDiarmis and C. E. Holden.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aberdeen, Md.—The town commissioners have purchased the site upon which to erect a new power house for the electric light plant.

Abbeville, Ga.—The recent special election resulted in favor of $20,000 5 per cent. water and electric light plant bonds.

Alpena, Mich.—At a council meeting it was resolved that a committee, consisting of F. C. Holmes, mayor, W. H. Davison, W. B Taber and H. Besser, be appointed with full power and authority to proceed at once with the construction of the electric light plant.

Amite, La.—The Amite City Light & Power Company has been incorporated with $30,000 capital stock, with Dr. C. S. Stewart, president. The company will operate an electric light plant, ice plant and waterworks.

Attalla, Ala.—The citizens have about closed the contract with Capt. W. P. Lay, of this city, to furnish the power for electric lights here.

Athens, Ill.—The electric light plant here was lately wrecked by an explosion.

Carrollton, Ga.—The mayor and council have announced the establishment of a water and light commission for the city. Judge W. F. Brown was elected for one year. At the recent election $45,000 worth of municipal bonds were voted for erecting an electric light plant, waterworks, etc., under municipal management.

Centralia, Mo.—A 10-year franchise has been granted to P. H. Baldridge to run an electric light plant.

Chicago, Ill.—Sketches are now being made for the new electric light plant to be erected on Fullerton avenue and the north branch of the Chicago River. The plant will cost $100.000 and will have a capacity of 3,000 street lamps, 500 of which are to be installed by January 1.

Douglas, Ga.—An electric light plant and waterworks system is to be installed here.

Front Royal, Va.—A new electric light plant is to be installed here.

Ft. Snelling, Minn.—Electric lights are to be installed here. R. N. Schofield is constructing quartermaster.

Harrisburg, Ark.—The business men of this city, have secured by subscription $4,000 for the purpose of establishing an electric light and waterworks plant. It is proposed to solicit from abroad the sum of $5,000 at least, which will only be accepted as stock on same basis as home subscriptions.

Harrison, O.—Adam A. Kramer, one of the incorporators of the new company which has just purchased the waterworks and electric light plant of this village, says: "We intend to give the village of Harrison, in time, one of the best electric light and waterworks systems in the State." C. J. Fleming is the new superintendent.

Leslie, Mich.—The Electric Light Company here has decided to purchase a new modern dynamo and a large alternating machine. This will necessitate a change in the street lights.

McKenzie, Tenn.—The capital stock of the McKenzie Electric Light & Waterworks Company has been increased.

New Orleans, La.—Two hundred new and improved arc lights are to be placed on various streets here by the New Orleans Railway Company.

Newport, Ky.—An eleetion is to be held in November to vote on the question of issuing $90,000 in bonds for the purpose of erecting an electric light plant here.

Ocala, Fla.—This city has voted to issue $45,000 bonds for electric light and debt liquidation.

St. Augustine, Fla.—An electric light plant is projected for this city.

Wilmot, S. D.—The question of installing an electric light plant here is being considered.

Winnipeg, Man.—The council of the city of Moose Jaw, has decided to borrow $75,000 from the Canadian Bank of Commerce to assist in the construction of the waterworks, sewerage and electric lighting system.

STREET RAILWAYS.

Bolivar, N. Y.—The project to connect this place and Wellsville by a trolley line has been revived.

Burlingame, Kan.—The survey on the Kansas City, Burlingame & Western Electric Railway has been completed as far as this city. The right-of-way is being secured without much difficulty, and deeds for about 10 miles have already been signed.

Clinton, Ia.—It is reported that C. H. Deere, of Moline, Ill., contemplates extending an electric line from Albany to this city.

Des Moines, Ia.—An electric line is projected between here and Boone.

Huntsville, Ala.—The Huntsville Railway Light, & Power Company is considering a proposition to build an electric railway to Monte Sano.

Manitowoc, Wis.—The Watertown Company has been given a franchise to operate an electric line through this city.

Marshall, Mo.—Col. Chase and Mr. Loomis, proprietors of the Missouri Central Electric Railway between St. Louis and Kansas City via this place, state that the road will surely be built. It is properly financed, and 80 per cent. of the right of way is secured, all except through Saline and Jackson Counties.

Mount Vernon, Ill.—The citizens have subscribed $4,000 towards the Southern Electric Railway Company, which is to be built from East St. Louis to this city. The bonds of the company have been contracted in a New York banking firm, the bankers agreeing to give an indemnifying bond that the road will be constructed.

Paterson, N. J.—Records in the courts here and at Hackensack indicate that the State Line Traction Company has acquired enough property in Passaic, Sussex and Warren Counties to complete a trolley line from this city to Suffern, N. Y. The line is to be used almost exclusively for the transportation of milk from places in these counties and in Orange and Rockland Counties, N. Y., to this city, and thence by the Hudson River Trolley Company, to New York. Eventually, it is said, the line will be run to Easton, Pa.

San Francisco, Cal.—The Northern California Counties Electric Railway & Steamer Line Company has been organized for the purpose of building an electric line to connect Marysville.

San Jose, Cal.—The San Jose-Los Gatos Interurban Railway Company has been granted a franchise to erect an electric line here.

Seguin, Tex.—Financial arrangements have been consummated for the preliminary survey of the proposed electric tramway to run from New Braunfels connecting with the International and Great Northern and Katy through this city and thence to Gonzales. This proposed line will cover a distance of about 44 miles.

Sharon, Pa.—The work of building the Sharon & Middlefield electric lines is to be rushed. The grading is fast nearing completion. Francis Morgan, of Cleveland, is at the head of the company. The line will be 45 miles in length, and will tap one of the richest farming districts in Ohio. At Middlefield, it will connect with the Cleveland & Eastern trolley line, giving a direct line from here into Cleveland.

Sherman, Tex.—After a conference of delegations from the various towns interested, held in this city recently, it was announced that the projected electric line from Bonham to McKinney via Edhube, Nobility, Randolph, Trenton, Blue Ridge and Vandosta, is assured, the bonus of $50,000 having been subscribed, together with 10 acres of land at each of the terminal points, and three acres at Nobility, where the power plant is to be located.

Trenton, N. J.—With its absorption of the Trenton & New Brunswick, the Public Service Corporation takes in its last link in a traction line across New Jersey, and will handle all traffic between New York and this city, connecting here with the Trenton & Camden trolley. As the Trenton & Brunswick was built under a steam road's charter, and can therefore carry freight and express matter, active competition with the Pennsylvania is expected.

POWER PLANTS.

Alcova, Wyo.—The Government has decided to put in an electric power plant at the site of the Government dam above here.

Lansing, Mich.—The firm of A. A. & F. B. Platt, of this city, have organized a stock company with $500,000 capital, for the purpose of developing water privileges on the Grand River in this city and Dimondale. This company proposes to furnish all the electric power needed here as cheaply as it is furnished at Niagara Falls.

Los Angeles, Cal.—A. J. Morganstern, of this city, heading a syndicate of capitalists, has projected a plan to harness the waters of San Joaquin River, above Pollasky, and generate electricity for the surrounding agricultural section. The undertaking will involve the expenditure of about $1,000,000.

Middleburg, Vt.—The Vermont Marble Company has secured a lease of the Belden Falls marble property and water power controlled by Mr. Worth and son, of Chicago. The new company is now engaged in putting in $200,000 motor power and will spend another $100,000 in perfecting the Proctor plant.

BIDS WANTED.

Middletown, O.—The specifications for a new electric light contract were adopted, and advertisements for bids, to be opened September 12, were ordered. The specifications call for 84 lights, inclosed arc, of 1,600 cp. each, at 70 volts. seven amperes.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12½@12¾c.; casting, 12⅜@12½c.

The Rolfe Electric Company of Rochester, N. Y., was incorporated at Albany on Monday with a capital of $150,000.

The Atlantic-Pacific Street Railway & Surety Company of Jersey City has been incorporated under the laws of New Jersey with $200,000 capital.

The foreclosure sale of the Atlantic Coast Electric Railroad Company, which operates around Long Branch, N. J., has been ordered under a $500,000 mortgage.

The directors of the Chicago City Railway Company meet the first week in September to act on the quarterly dividend. The usual rate of 2½ per cent. will be declared.

Since the Chicago Edison Company has made a specialty of furnishing power to small concerns, it is said, working forces installing such plants throughout Chicago have been nearly doubled.

The Central Trust Company will pay the coupons due September 1 from the first mortgage 5 per cent. gold bonds of the United Traction & Electric Company, Providence & Pawtucket (R. I.) issue.

The Rochester (N. Y.) Railway & Light Company has declared a dividend of 1 per cent., payable September 1. This is the first dividend disbursement of this new company which is a consolidation of the Rochester Railway Company and the Rochester Gas & Electric Company.

The stockholders of the Union Traction Company of Philadelphia at the annual meeting September 21 will be asked to ratify the issue of $1,000,000, four and-a-half per cent., 30-year bonds of the Willow Grove Electric Railway Company. These bonds will be redeemable at 105 and guaranteed by the Philadelphia Rapid Transit Company. They will pay for construction of the road.

Richard Siegman of New York on Monday filed in the Court of Chancery at Trenton, N. J., a bill against the Electric Vehicle Company, Martin Maloney and others, as directors of the company. The purpose of the bill is to compel Maloney and the other directors to make good $704,800, which was paid out by the Electric Vehicle Company in dividends during 1899 nd 1900.

John O. Howard, representing a syndicate, has bought the Wheeling & Elm Grove Railroad for $1,250,000. This is part of a deal that will include every road entering Wheeling, W. Va. The Wheeling Traction, the Handle Traction Company, and the City Railway Company have all agreed to sell. These roads have 107 miles of track and will bring close to $10,000,000. It is believed the purchases are being made for a syndicate of New York and Pittsburg capitalists, headed by the Flynn interests, who are building from Pittsburg to Washington, Pa.

The directors of the Kings County (Brooklyn) Electric Light & Power Company have given notice to the stockholders that the remaining treasury stock, amounting to $1,250,000 par value will be issued to them at par proportionately. Each stockholder of record at the closing of the books on September 6 will be entitled to subscribe for the new stock to the amount of one-third of his present holdings. The right to subscribe will expire on September 16. The payment for the stock must be made one-half on or before October 1, 1904, and the balance on or before January 3, 1905. Stockholders not wishing to subscribe may sell their rights.

ELEOTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Aug. 29
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	155⅝
Metropolitan Street Railway	122¼
Metropolitan Securities	90⅛
Ninth Avenue	195
Third Avenue	125
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	237
Brooklyn Rapid Transit	54⅛
Public Service Corporation (New Jersey)	98
Philadelphia.	
Consolidated Traction of New Jersey	70
Philadelphia Traction	98⅞
Union Traction	54¼
Boston.	
Boston Elevated	150½
Massachusetts Electric Companies, com	15
do. do. do. pref.	62½
West End Street, com	91½
do. do. do. pref.	111¼
Chicago.	
City Railway	168
North Chicago	71
Union Traction, com	5½
do. do. pref.	30

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Closing price Aug. 29
New York City.	
Allis-Chalmers, com	11
do. pref.	50
Electric Boat, com	40
do. do. pref.	75
Electric Lead Reduction	¾
Electric Vehicle, com	9¾
do. do. pref.	14
Westinghouse, com	159¼
do. pref.	180
General Electric	166
Boston.	
Edison Electric Illuminating	263
General Electric	166
Westinghouse Electric & Mfg., com	80
do. do. do. pref.	90
Chicago.	
Chicago Edison	145
National Carbon, com	35¼
do. do. pref.	107
Philadelphia.	
Electric Company of America	9¼
Electric Storage Battery, com	61
do. do. do. pref.	61

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price Aug. 29
Boston.	
American Telephone & Telegraph Company	138
Western Telephone Company	14
New England Telephone Company	123¾
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	180
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	90
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..

MISCELLANEOUS STOCKS.

Name.	Closing price Aug. 29
Otis Elevator Company	35
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

The International Electrical Congress.

Before we go to press again the International Electrical Congress will have convened in St. Louis. As is generally known, the opening services will be held on September 12, at 9:30 A.M., in the Music Hall of the Coliseum.

At this gathering delegates and well-known scientists from almost every civilized country of the world will be present. England, Germany, Italy, Switzerland, Norway, Sweden, India and Mexico are a few of the nations that will be represented, and it is expected that no less than 170 papers will be read.

The work of the Congress will be divided into eight sections, the subjects of which are: General Theory, General Applications, Electrochemistry, Electric Power Transmission, Electric Light and Distribution, Electric Transportation, Electric Communication and Electro-Therapeutics. Among other well-known scientists, there will be present Sir William Ramsay, the noted English chemist, who has just arrived in this country.

Sir William Ramsay was the first to obtain helium, and discovered the gas known as argon. Since the discovery of radium much of his research has concerned this element, and it is thought by scientists that he has new discoveries which he is about ready to announce. It is said that he will give out the latest result of his researches in a paper which he will read on September 22 at St. Louis, entitled "New Problems in Inorganic Chemistry."

There is little doubt but what the coming International Congress will be looked upon by noted scientists and engineers as a fitting and appropriate time to announce new discoveries, or to suggest new lines of investigation, which should in time prove invaluable to the commercial world. The programme of the Congress and further details will be found elsewhere in this issue.

* * *

Electrical Sensationalism.

A writer for a Glasgow engineering journal thinks that the newspapers of the day are wrong in making sensational articles out of ordinary electrical enterprises. And he is right. The article among other things says:

"We must candidly admit that the number of electrical undertakings in progress or projected are constantly being added to, and that these must naturally come under the observation of the journalistic scribe, yet we do sometimes think that undue prominence is given in the public prints to minor schemes of this kind; that the same phraseology is too freely used, and that there is a distinct and unnecessary tendency on the part of some writers to clothe their thoughts in fine, flowery language when dealing with the marvelous agent or force we are now adverting to. Seriously, we feel sure that this class of critics would interest and enlighten their readers in a much higher degree, and at the same time produce better 'copy,' if they limited themselves to a plain statement of facts embodied in the simplest language possible and freed from superfluities."

It is only necessary to pick up a Sunday newspaper to see that the author of the article in question is right. There frequently appears sensational accounts accompanied by wonderful and weird illustrations descriptive of some very ordinary electrical phenomenon. Such articles give to the general public a mistaken idea and naturally lead them to think they

are living in a miraculous age. The present era is undoubtedly one of wonderful achievements, but the time of miracles is past and the things that have been accomplished by the aid of electricity were brought about through days and nights of hard work in the past of one or more individuals and not through Divine inspiration.

* * *

Conditions in the Philippines.

Recent advices from the Philippines state that the German-Dutch syndicate headed by the Dresdner Bank, which has for some time been engaged in promoting a company to lay the projected German-Dutch cable in the the Far East, has now brought its negotiations to a successful issue, a company to be known as the German-Dutch Telegraph Company having been definitely formed with its head office in Cologne, Germany. Its capital stock is placed, in round numbers, at $1,632,000.

The cable which this company proposes to lay and work will run from the Dutch Settlements in the Celebes to the Island of Yap in the Pelew Archipelago, and thence to Shanghai and the Island of Guam, where it will connect with the Pacific cable of the Commercial Cable Company. The company will receive an annual subsidy from the German and Dutch Governments of $460,985. The sum of $3,524,675, which will be required for the laying of the cable, will not be provided for by drawing on the capital stock, but will be procured by the issue of bonds, the interest and redemption of which will be guaranteed on the security of the subventions.

Electrical industries are progressing throughout the islands as fast as can be expected, when the present primitive conditions are taken into consideration. During the month of March last, the latest period for which any official statistics have been compiled, the importations of electrical cars were valued at $2,820, all of which were shipped from the United States. For the nine months ending March 31, however, this is the only importation shown. The value of the importations of telegraph, telephone, and other electrical apparatus for the month was $7,640, as against $1,619 in the corresponding month for 1903. Of this sum the United States led with a value of $4,602, Germany standing second with $2,368. For the nine months the values were as follows: in 1902, $17,617; in 1903, $68,227, and in 1904, $35,833, the decrease being entirely in the exports from the United States, all other countries showing an increased value. Under the heading of incandescent lamps we find that the month shows a value of $1,165 as against $3,198 last year. For the nine months there has been an increase from $814 in 1902 to $11,168 in 1903, falling again in 1904 to $4,022, the United States in the lead, with Germany a close second. There seems to be a general indication of an overstocked market in all lines of merchandise, still it must be admitted that there is a large and growing market to be worked for and controlled as soon as other conditions can be sufficiently advanced.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The foreign electrical engineers rode through the subway in this city on Monday and in the evening were the guests of the American Institute of Electrical Engineers at a banquet at the Waldorf-Astoria. The visiting engineers accompanied by the New York committee and others started for St. Louis yesterday.

Prof. Goldsborough has appointed Dr. A. E. Kennelly and Mr. Carl Hering members of the Electricity Section of the International Jury of Awards at the St. Louis Exposition.

The Bureau of Equipment of the Navy Department at Washington will recommend an appropriation of $300,000 for wireless telegraphy installation and apparatus for 1906.

The fast expresses on the New York, New Haven & Hartford Railroad between New York and Boston will be lighted by electricity in place of gas within a short time.

The Colorado Electric Light, Power & Railway Association will meet at Colorado Springs September 21.

The independent telephone companies of northern Ohio have organized an offensive and defensive alliance against the competition of the Bell companies.

The conditions of a concession to a financial syndicate for an electric railway up Mont Blanc are, according to the Paris correspondent of the London *Standard*, as follows: The line is to start from Le Fayet, St. Gervais, and the route to be followed is to include stations at St. Gervais-les-Bains, Motivon, the Col de Voza, the Pavillon de Bellevue, Mont Lachat, Les Rognes, Tete Rousse, and the summit of the Aiguille du Gouter. The final plans are to be presented within a year of the signing of the decree, and the construction of the railway must be commenced within another year, and prosecuted in such a way that it is completed within a period of six years from the commencement of the work. The gauge of the railway is to be 3.28 feet, and the minimum number of journeys to be made daily each way from June 15 to September 15 is fixed at two. The trains will be composed of two cars, and the maximum speed is to be five miles an hour. The fares will be calculated upon a scale of 50 cents per mile, and for goods or baggage the rate is to be $1 per ton per mile.

Considerable electrical equipment, including several cranes, are to be purchased for installation on the extensive Vera Cruz docks, the contract for the construction of which is in the hands of the British contracting firm of S. Pearson & Son, Limited. Some idea of the magnitude of the equipment to be purchased will be gathered when it is stated that upward of $30,000,000 (Mexican currency) are involved in the contract for the construction of the docks.

Contracts are expected to be placed in this country shortly for material to be used in the construction and equipment of the San Juan-Ponce electric road in Porto Rico. The system will entail an expenditure of some $2,000,000.

A movement is on foot to organize a company for the purpose of building an electric railroad at Rosario, a city of about 122,000 inhabitants, in the Province of Sante Fe, Argentine, S. A.

According to some figures given by the London *Electrical Engineer*, and obtained from Germany, the trackless overhead trolley car, capable of holding 22 passengers, uses about the same amount of electric current as an ordinary street car with accommodation for 28 passengers, representing a higher cost of some 25 per cent. It should also be remembered that the maintenance of the cars, owing to a greater wearing out of the rolling stock and extensive need of lubricators, etc., is larger than on track cars, though in the latter case provision has to be made for repairs to the permanent way. The total operating costs worked out at about 8 cents per mile. A large part of the income of these trackless roads is obtained by carrying goods. It has been found that the streets are not at all injured by the trackless cars.

THE ORLING-ARMSTRONG ELECTRO-CAPILLARY RECORDER.

There having been a number of improvements made during the past year or two in the Orling-Armstrong Electro-Capillary recorder, the *Electrical Review*, of London, gives an account of the improved apparatus as follows:

Fig. 1 shows in section the working parts of one form of recorder. The principle of the device is the same as that of Lippmann's electrometer, its action depending upon the change of surface tension at the bounding surface between

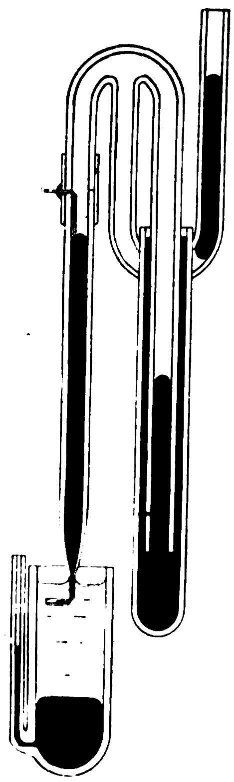


Fig. 1.

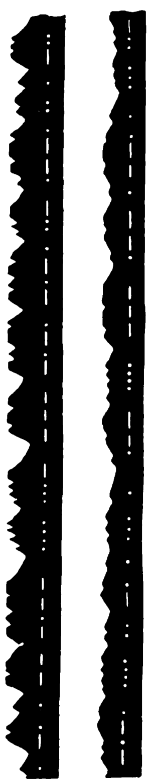


Fig. 2.

mercury and dilute sulphuric acid when a difference of potential is established between the two media. In the relay this change was utilized to cause mercury to flow out of a capillary tube, actuating a mechanical device directly, or closing an electric circuit, which produced a similar result. In the recorder, however, the mercury never flows out of the capillary tube, but rises and falls in the latter according to the sense of the potential difference.

In Fig. 1, T is the tube containing the mercury column, and ends in a fine capillary extension under the surface of dilute sulphuric acid; the capillary portion is bent at right angles to the tube, and the bonding surface between the two liquids is at the middle of the length of the horizontal portion. Connection is made with the mercury by means of a platinum wire fused into the glass, and with the electrolyte by means of a quantity of mercury, as shown. A difference of potential being established between the terminals, the end of the fine thread of mercury either approaches or recedes from the aperture of the tube, according to the polarity employed, and by means of a suitable projection apparatus the magnified image of the thread is thrown upon a traveling sensitized tape, producing records of the type shown in Fig. 2. The additional tubes shown in Fig. 1 are intended merely to adjust the position of the mercury thread in the capillary tube, and we may mention that the same object was achieved in a far simpler manner in the apparatus which we inspected. The adjustment once made remains constant, the end of the thread coming back to the zero position with certainty, directly the potential difference is removed. Fig. 3 shows a complete recorder, including the projection apparatus, a light-tight box inclosing the sensitized tape, and a motor to drive the latter. A Nernst lamp now replaces the arc lamp illustrated, and instead of the light proof box being used, the tape may be exposed through a narrow adjustable slit in the wall of an ordinary dark room, so that the tape can be developed and fixed continuously as it receives the photographic impression.

Turning to the practical applications of the device, we must promise that practically no current flows through it, the action being due to polarization at the surface of the electrolyte; hence an infinitesimal amount of power is required for its operation, and it is exceedingly sensitive. One-third of a volt, working through a megohm amply sufficed on the occasion of our visit. Herein lies its peculiar suitability for use as a submarine cable recorder, fulfilling the functions of the siphon recorder, and the inventors claim that it can be worked at least twice as fast as the latter; moreover, we are informed that it has been so operated on Atlantic cables, and in addition that it has been used on the land lines of the post office from London via Glasgow and Edinburgh to London, recording messages transmitted by the Wheatstone transmitter at the rate of 360 words per minute. We need not dwell upon the extensive field open to such an apparatus in this direction. It is worth mentioning that owing to the great sensitiveness of the instrument, a very low battery power is required, even with submarine cables, and we are assured that communication can be maintained even when the cable is severed, by induction across the gap.

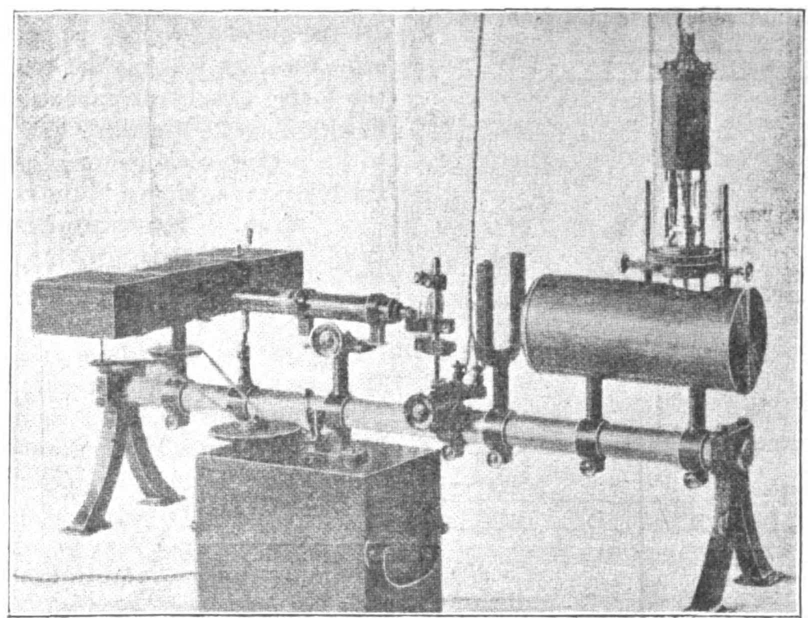


Fig. 3.

The recorder is also applicable to wireless telegraphy, being used in series with an ordinary coherer; and the special feature of this application is the fact that when practically no current is allowed to pass through the coherer, as in this case, the latter is self-decohering. Thus Morse signals can be recorded as easily as in telegraphing through wires.

Communication has been effected, we are told, between London and New York without any intermediate relay or repetition of the messages, by means of the instrument. A large number of recorders can be connected in parallel without detriment to their efficient working, and the rapidity with which the device responds to electrical impulses appears to be remarkably great; a tuning-fork, for example, sounding into a telephone receiver connected with a recorder, suffices to produce a record of its beats, and this suggests other applications for the instrument, besides demonstrating its capabilities. We trust that by its means import-

ant improvements may be effected in telegraphy of all descriptions.

WRINKLES.*

EDITED BY CHARLES H. WILLIAMS.

THAWING WATER PIPES BY ELECTRICITY.

Referring to the accompanying diagram, a simple method of thawing out frozen water services by means of electricity is shown.

From the 2,000-volt primaries taps are led to a primary fuse box, from which the primary wires are connected to a 20 kw. transformer. In the leads of the secondary transformer is placed a secondary switch, from which one lead is carried to an iron plate at the bottom of a barrel of water. In the upper part of the barrel is placed a movable iron plate from which

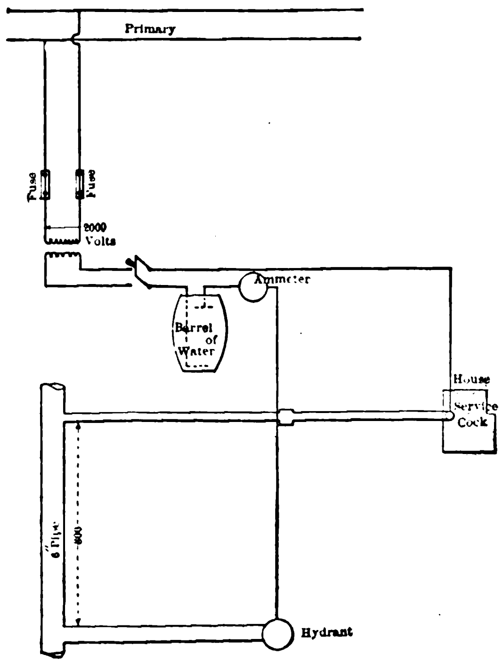


DIAGRAM OF CONNECTIONS.

the current is conducted through an ammeter, thence through a lead of heavy wire to a nearby fire hydrant. The secondary current is then conducted through the iron branch pipe, thence through an 8-inch or 6-inch cast-iron main, then through the service pipe to the service cock in the house. At this point a heavy copper wire is connected to the service cock, and this wire, leading back to the transformer, completes the secondary circuit. This is the connection that is necessary if a service pipe is frozen between the main and the house. If the pipe is frozen between the service cock and the house connect an iron wire on to the service cock instead of connecting the wire on to the hydrant, as shown in the sketch, which arrangement will place only that part of the pipe in circuit which lies between the service box and the service cock in the house.

By means of the movable plate in the barrel the amount of current used can be regulated from zero to the capacity of the transformer. The lower the secondary voltage that will force a sufficient number of amperes through the pipe, the greater the economy. From 200 to 300 amperes will be needed.

The transformer may be loaded on to a wagon and left standing close to the house where the pipes are frozen, and it will be necessary then to use but a small amount of heavy wire, as No. 6 wire will be of sufficient capacity to carry the primary current from the primary leads to the transformer.

Where two services in adjacent buildings, or in buildings in the same block, are frozen, the two may be thawed at the same time, by making the connection to the surface cocks or faucets in the two houses, instead of making one connection to the service cock and one connection to the hydrant, as shown in the sketch.

A. G. SANGSTED-DISRAELI,
Quebec, Province Quebec.

A HANDY MAGNETO ARRANGEMENT.

One of the difficulties encountered in the meter and arc lamp repair shops is in "ringing out" coils, circuits, etc., in meters, arc lamps and motors with a magneto, with only one person to perform the task. The two terminals of the coil that are to be rung out may be quite distant from each other, and difficult to make contact with, thus rendering it exceedingly difficult for one man to apply the magneto terminals, and, at the same time, revolve the generator.

An easy way to eliminate this difficulty is to install the magneto generator in close proximity to a line shaft that is in constant use for other purposes, and belt the same to it by means of a pulley, replacing the crank. Two leads may then be run to the repair shop, where the bell or ringer may be installed near the work bench. The two leads from the ringer coil may be long enough to reach to any part of the bench or rack, and at the same time not be in the way when not wanted. In this way, since the magneto is always in operation, all that is necessary in order to ring out a circuit is to pick up the two terminals and make the required contact without reserving one hand to turn the generator.

JOHN CORSCOT, JR., Madison, Wis.

A STRONG ARGUMENT USED TO FORCE THE SETTLEMENT OF A BILL.

A certain manager of a small electric light company in one of the northwestern States advertised the fact that his company stood ready to serve the public by thawing out frozen water services at $10 each, and as the cold was unusually severe numerous orders were soon placed on his books.

Including the time necessary for making the connection, etc., about two hours was usually consumed in completing a thaw. On one occasion he had just finished thawing out a service when an old German, living in an adjoining house, made up his mind that it would be cheaper to pay the $10 than borrow water until spring, when the frost would leave of its own account, so that the connection was quickly changed, and about three minutes after the current was turned on the water began flowing from the faucet. It did not seem just to the old man that he should be required to pay $10 for this service when barely 15 minutes had been consumed in the entire operation, and he entered a decided protest against the payment of the bill. After the old man had finished his abuse of the electric company, the manager asked him point blank if he refused to pay the bill now that the work was done, to which he answered in the affirmative. Turning to his assistants, the manager said, "Reverse those connections and freeze him up again." But the old man wouldn't stand for that, and the bill was quickly paid.

L. STRONG, Champaign, Ill.

GENERAL USE OF ELECTRIC ELEVATORS IN MODERN OFFICE BUILDINGS.

In seeking business for new buildings, particularly the modern office building, it has been our aim to induce the owners or trustees, as the case may be, to install electric elevators, as this insures us a steady business for our day load factor.

After considering the low price of installing same, as compared with the hydraulic type together with the economy of space, etc., comes the cost of operating. We have found that by offering a flat sum per year per elevator for a term of not less than three years, provided we also have the entire lighting of the building, it has appealed to the customer so favorably and proved so satisfactory to both parties, that nearly all of the new buildings erected since we adopted this plan have put in electric elevators and taken power from the central station. In a great many instances this has been the means of getting the electric elevator installed where the hydraulic type was seriously considered, and we believe this is one reason why so few hydraulic elevators are now being put in here; for in the

*Paper presented before the National Electric Light Association at its 27th Convention held at Boston Mass., May 24-27, 1904.

past 12 months there have been contracted for and installed in newly erected buildings alone some 90 electric elevators, which are operated from the central station.

We claim that our efforts in this direction have helped the owners of these large buildings in reducing their operating expenses, as the expense for elevator service and public lighting is an item that is borne by them, and as there is always the question as to whether they cannot install their own electric plant and produce current for less than by taking it from the central station, we think the above results answer the question as to which is the cheaper.

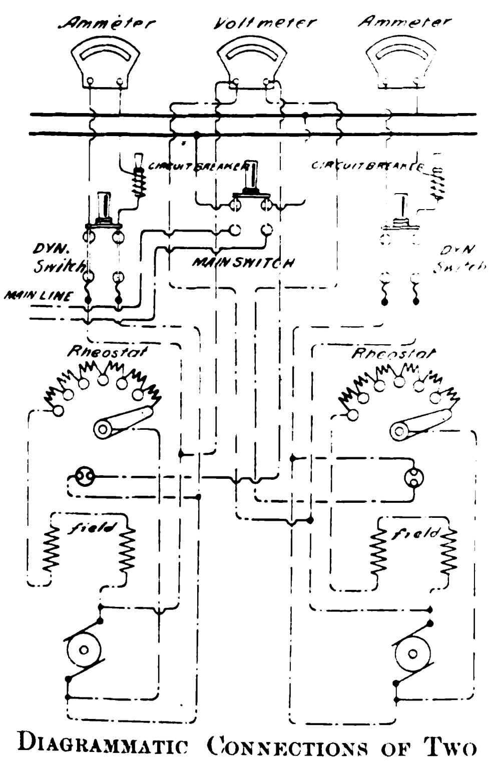
Edison Electric Illuminating
Company of Boston.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 122.*)

Connecting Two Shunt Wound Dynamos.—The method of connecting two shunt wound machines in multiple is shown in the sketch. A certain amount



Diagrammatic Connections of Two Shunt Dynamos in Multiple.

of care must be exercised, because both are generators of electro-motive force, and in consequence conditions result which would be dangerous if disregarded when both machines are in operation. Both machines may run as follows:

First—Both at equal pressure.

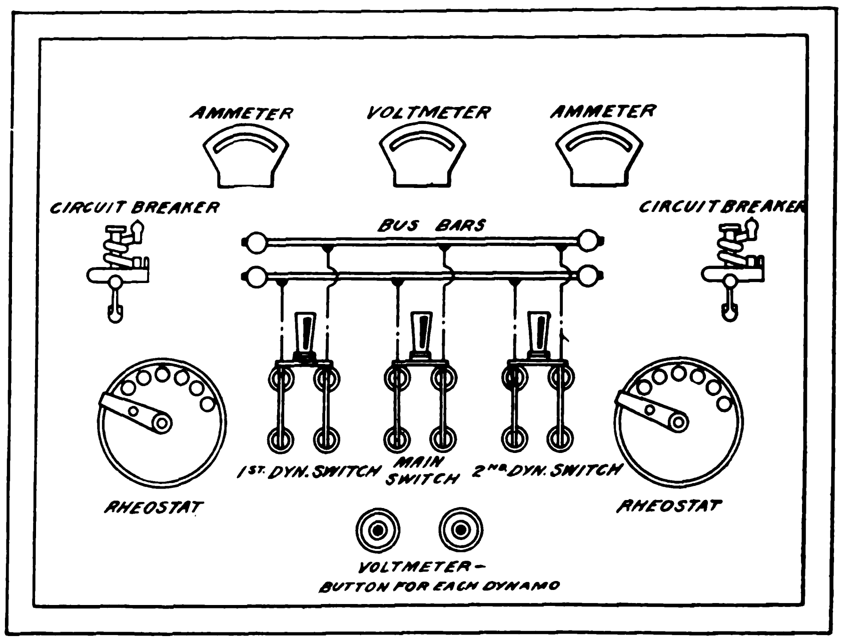
Second—Both at unequal pressure.

Third—One as a dynamo and one as a motor.

In order to have both run at an equal pressure, first one is allowed to run until its EMF. is correct, the switch of the other machine being open, then the process covers the following as regards the other. The second machine is brought up to speed and its pressure made to tally with the first machine. This is accomplished by means of the regulating device or rheostat, whose action is recorded by the voltmeter. By means of these two devices the pressures are made to correspond with great exactness, before the main switch from the second dynamo is thrown in. When both dynamos are of equal pressure the main line switch is thrown in and this immediately calls upon the two dynamos for power. If they are alike in construction the variation in load will not be very great, but this is not apt to be the case, and the pressure of each must be again regulated until they are approximately correct. This is an operation requiring some skill and practical experience before it is done quickly and without risk.

Unequal Pressures.—The risk mentioned is that due to the unequal pressures, which cause the loads on the machines to be unequal and thereby throws too much on one and too little on the other. This is apt to cause overheating of the armature and if sustained over a long period a possible burn-out. Another danger is present however, and this is due to the fact that one may run as a motor if its pressure falls very far below the other.

Under these circumstances the fields will remain as before, and the dynamo will continue to run in the same direction as a motor, because the current is now entering the armature in the opposite direction. This experiment can be readily tried with a small experimental shunt dynamo. The machine may be used as a generator with separately excited fields. If a reverse current is suddenly switched into the armature it will continue to run in the same direction as a motor. In the sketch two 'bus bars are employed to which the main line switch is connected and from which the pressure at the generators is readily obtained. The entire regulation in the case of two or more shunt wound dynamos running in parallel consists in looking out for the equal distribution of the load by means of the regulating rheostats. In the sketch is shown the appearance of the

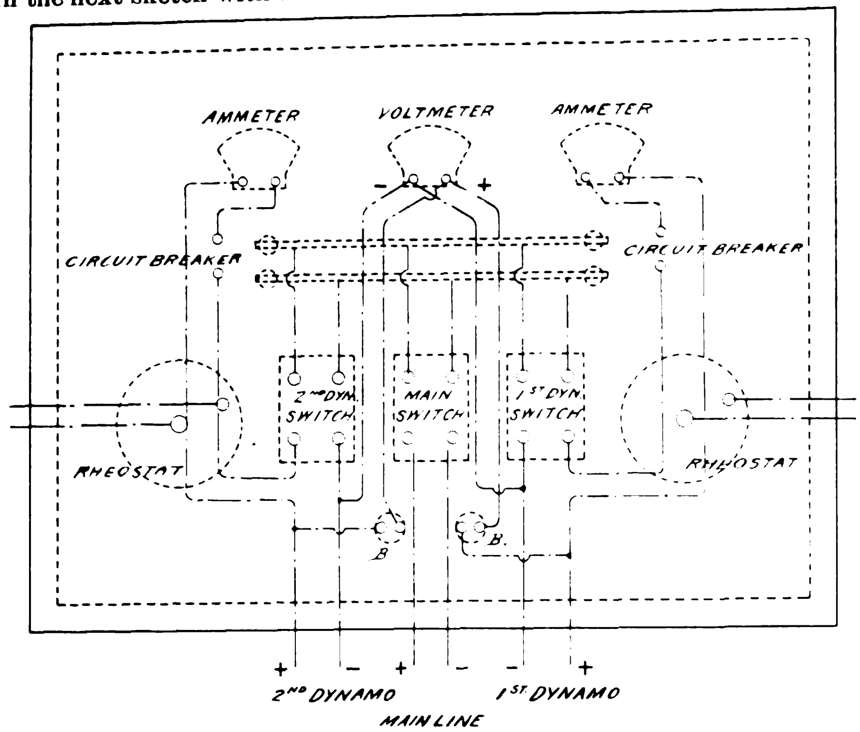


Front View of Switchboard of Two Shunt Dynamos in Multiple.

switchboard with all the instruments and switches mounted. Two push buttons are used for testing for the pressure of each dynamo respectively. The 'bus bars are also in evidence, and in this case they simply consist of solid bars of pure copper to which all three switches are joined by copper bars.

It is easy to see this connection in practice. First the two dynamo switches which convey the current from the dynamos to the 'bus bars; then the main line switch through which the total current passes to the lighting or motor circuits. Each of the dynamo circuits has in series with it a circuit breaker, which protects the dynamo to which it is connected from an abnormal load. There are non-arcing fuses mounted on the switches as an additional protection. It is also possible to have but one circuit breaker in the main line and thereby dispense with the two used in connection with the dynamos, but individual protection for each machine is by far the best policy in general switchboard design. The use of two voltmeters instead of one is also the best practice although not absolutely necessary.

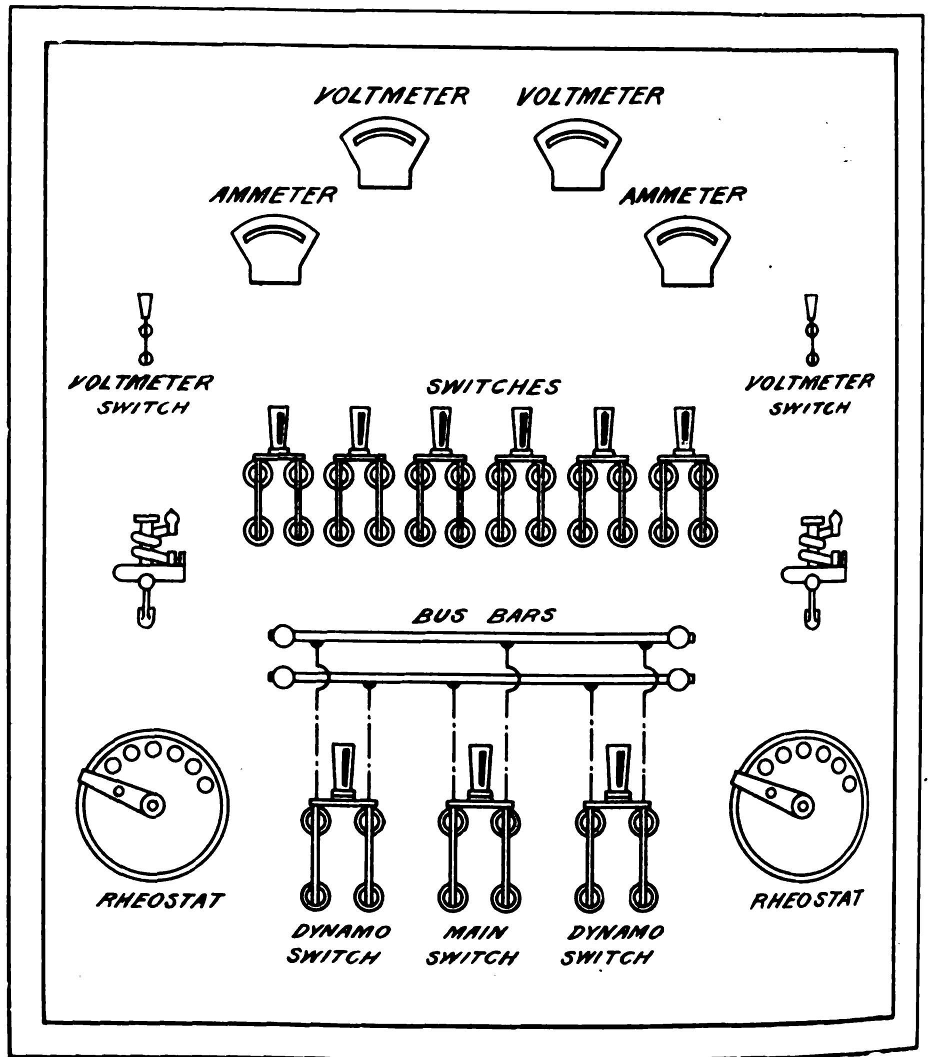
The rear view of the switchboard is shown in the next sketch with the connections to the different devices on the face of the board. In all cases where a single voltmeter is used with push button contacts from each dynamo care must be taken that each pole is connected right or a short circuit will result at the voltmeter binding posts or poles. The main circuit from each dynamo runs through the ammeter in series with which is the circuit breaker as shown. Two conductors of flexible cable lead the current from each dynamo respectively into its controlling switch and thence into the 'bus bars. From the 'bus bars through the main switch the current is led out to the distributing circuits. In this case the circuits on the different floors are not individually controlled from the switchboard. If it is necessary to do this, the switchboard becomes a little more elaborate and the switches controlling the different floors must be shown on the face and back of the board.



BACK VIEW OF WIRING CONNECTIONS OF TWO SHUNT DYNAMOS IN MULTIPLE.

The control of different floors by means of the switchboard is required in complete equipments. A case of this kind is exhibited in the illustration where six separate circuits, each with its main switch, compose one section of the switchboard.

The back and front appearance are shown, with all apparatus mounted in its place, and all wiring connections complete. It must be understood that if there are many changes in the load the switchboard will not help to regulate it. It only serves as a convenient place on which to group the different devices and at which to concentrate all the principle circuits. If the variation of load due to changes in the number of lights on the different floors is very marked, it will be necessary to regulate by the rheostat as often as is necessary. In some plants of this description this is inevitable and represents one of its greatest drawbacks. If this rheostatic regulation is not attended to, the load upon the machines will distribute itself unevenly, and may affect their speeds if the difference in balance is too great. In this case an overload would result, on either one or the other dynamo, and the circuit breaker will act, cutting open that circuit, as the case may be. (See illustration on following page.)

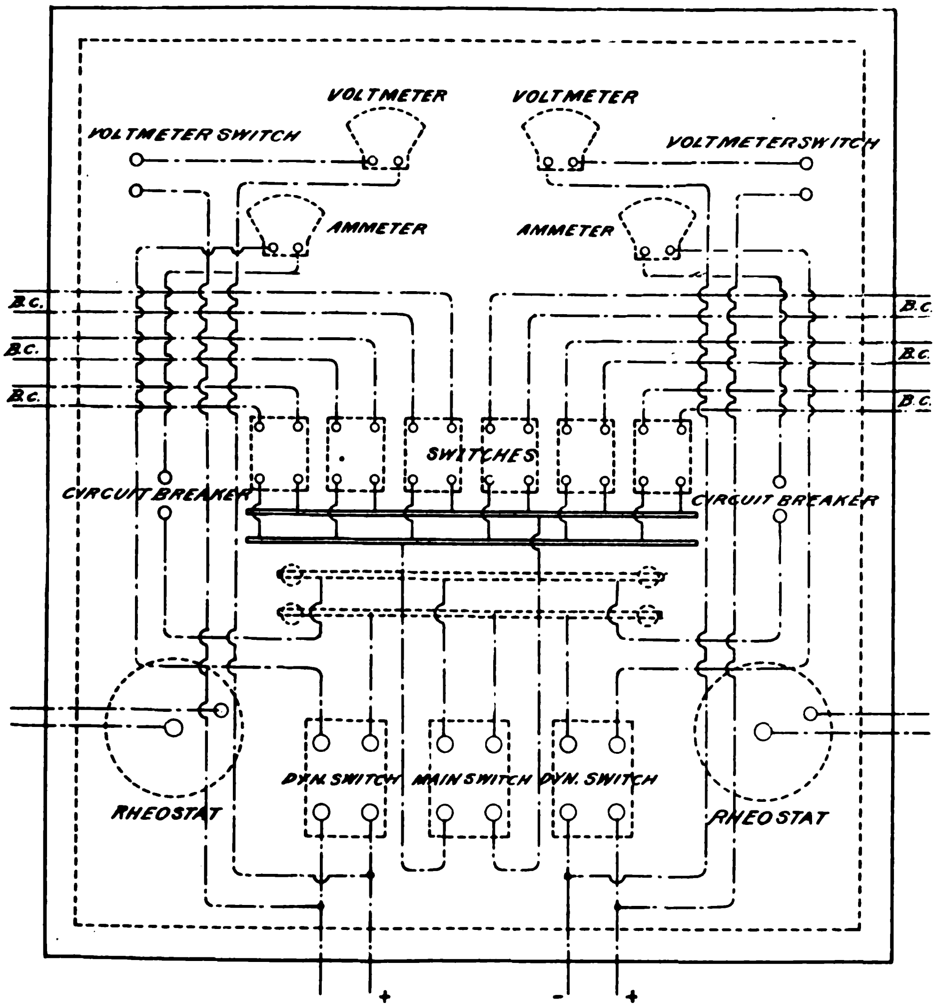


FRONT VIEW OF SWITCHBOARD WITH TWO SHUNT DYNAMOS IN MULTIPLE, SHOWING MAINS TO VARIOUS FLOORS.

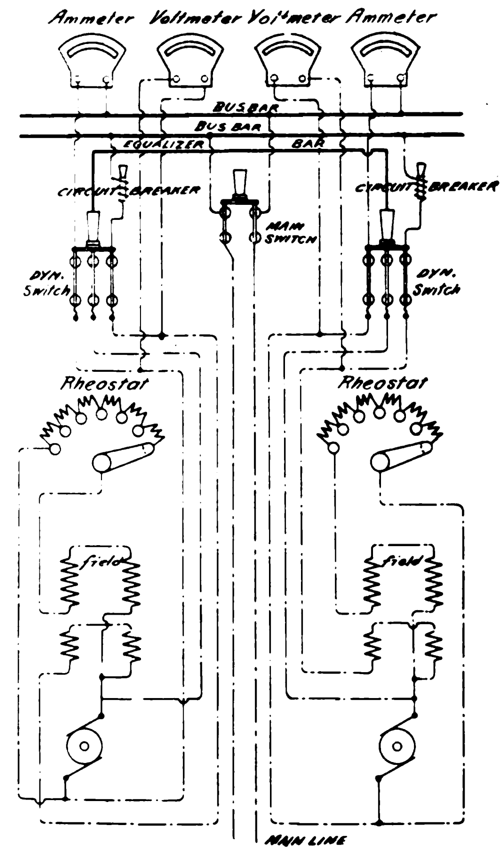
The only satisfactory way in which two generators can be run automatically with safety under all reasonable changes of load, and still preserve the pressure at its proper value, is by installing two compound wound dynamos, and attaching them in multiple to the switchboard as shown. Both shunt and compound wound dynamos are included under the technical appellation "constant potential machines," but they differ from each other, as has been previously pointed out, in their field windings. One has merely the ordinary shunt winding, the other has also a shunt winding, but a series winding in addition. In fact a compound wound dynamo, as far as its windings are concerned, consists of a series wound and shunt wound generator with their wind-

ings, as it were, superposed upon each other.

The Equalizer.—The automatic regulation is accomplished by the series coil, and it is therefore necessary when two machines of this type are connected in multiple to secure the correct action of each by means of what is commonly termed an "equalizer bar." This bar simply connects one brush of each dynamo to the corresponding brush on every other dynamo connected to the series coils. In the case represented only two dynamos are in multiple, and it will be seen that the equalizer bar in this case was from the upper brush of one dynamo to the upper brush of the other; but it will be noted that this upper brush also feeds into the series coil of each dynamo respectively. If the idea is carefully followed out the diagram will also show that the upper brush of each generator can send its current either into the series coil or into the equalizer bar. If the potential at each of these brushes is alike, the equalizer bar carries no current; but if the pressure generated by one dynamo is a little higher than the other, due to the fact that the speed of either one has diminished, or the load on one is greater than that on the other, then, current from this brush of higher potential, will flow through the equalizer bar into the series coil of the other dynamo. The effect of this is to strengthen its magnetic field, thereby increasing its electromotive force and in this manner augmenting the pressure until both machines in this respect are in equilibrium. But it is also evident that when one machine builds up the series coil of another in this manner, it is at the expense of its own, therefore as the pressure of one machine rises, the pressure of the other machine falls until both are *equalized.* The equalizer circuit should be closed before the other circuits, and to accomplish this it is often the practice to either have a separate switch in this circuit, or to provide a longer blade to the middle of the switch shown, so as to close this first as described. The two main wires running across in the last sketch, are 'bus bars of heavy copper, and feed the main line, or supply current, to a variety of switches connecting with the various floors or circuits of the building. The equalizer should be of very low resistance, otherwise the drop through it may rise too high, if for any reason it ever carries a considerable volume of current. By having it of ample cross section, the regulation may be carried to a fine point. In large plants, where several thousands of amperes may be generated, a sudden variation in load will be the cause of a heavy current flowing, which might develop a heavy drop in the "bar," if the resistance is not low. For instance, a resistance of .001 of an ohm, with a current of 100, 1,000 and 2,000 amperes respectively, means a drop of $\frac{1}{10}$, 1 and 2 volts. This is very much accentuated, if the resistance of the bar is more, which, in some instances, it is very likely to be.



BACK VIEW OF SWITCHBOARD WITH TWO SHUNT DYNAMOS IN MULTIPLE, SHOWING WIRING CONNECTIONS TO MAINS FROM 'BUS-BARS.



DIAGRAMMATIC CONNECTIONS OF TWO COMPOUND WOUND DYNAMOS IN MULTIPLE WITH EQUALIZER BAR CONNECTED.

Series Fields.—The adjustment of the series coil is also a matter of the greatest practical importance. The amount of current it carries may be too great or too small. If this is the case, it is now the practice to regulate with a shunt placed in multiple with the series winding, to vary the current within certain limits.

This variation of the current is necessary because in some instances the ampere turns of the series coil are too great. It is not practical to cut down the turns after a dynamo is completed, but it is very easy to shunt part of the current and thereby reduce the magnetic effectiveness of the series coils. The adjustment of the pressure of a compound wound dynamo is thus made possible within very fine limits by this means. When it is desirable to over-compound a generator, the regulating of the resistance of this shunt is a

rapid and practical process. In tests where the regulation of a dynamo is limited by specifications to a few volts, from no load to a full load of 500 amperes, such adjustment as this is appreciated in a commercial as well as a scientific sense.

Over Compounding.—A dynamo is said to be over-compounded if the series coils more than compensate for the various losses in the way of drop in the armature and armature reaction. A dynamo is over-compounded, so that it will generate enough extra pressure to equal the drop experienced in the conducting wires. The theory of the compound wound dynamo, fully covers this ground, yet it may be condensed into a convenient form under the following headings:

PURPOSE OF THE SERIES WINDING.

First—To compensate for armature reaction which cuts down the useful lines of force.

Second—To compensate for the drop caused by the armature current flowing through the armature winding.

Third—When over-compounding, to compensate for the volts drop in the main lines and feeders.

Fourth—To provide automatic regulation for all loads.

The over-compounding may be from 5 to 10 per cent. of the normal pressure, but this it largely governed by the percentage of drop in the wiring system. The method of compounding in general is of importance with respect to the wiring proposition, for the reason that regulation at different points of load if ineffective will mean poor lighting. Where the entire plant must be installed, as well as the wiring, the selection of the dynamo, whether shunt or compound wound, cannot be intelligently made unless a full knowledge of the requirements of such a machine are in possession of the purchaser. It is advisable to select an over-compounded machine and modify the degree of the over-compounding by manipulating the german silver shunt attached in multiple with the series coil. If the resistance of this german silver shunt is increased, the over-compounding will increase, that is to say, more current will flow through the series coils. But if the resistance of this auxiliary shunt is diminished, then less current flows through the series coils and the additional voltage they are the means of generating is cut down. Under ordinary conditions a compound wound dynamo simply preserves externally a uniform pressure, but if the drop outside will not allow of this condition prevailing then over-compounding is resorted to and the building up of pressure takes place externally, hand in hand with the increase of the load.

Street Railway Plants.—Compound wound generators are used exclusively in street railway power houses. In stations of this character a sudden change in load of from 100 to several thousand amperes is not an unusual occurrence, and for that reason the utter futility of installing any other class of direct current generators has been repeatedly exemplified in the early history of street railway practice. The compound wound dynamo is the only practical solution of the lighting problem for private plants and street railway service, and its automatic regulation in well-designed machines leaves but little to be desired. In street railway service the large switchboards are well equipped with automatic circuit breakers to avoid burn-outs.

The compound wound dynamo particularly requires the installation of these devices, because when short-circuited all the effects of an abnormal load are in evidence and *the pressure is preserved.*

Serious damage would result if this, at times of terrific strain, were not relieved by means of the circuit breakers. It is not alone the dynamo which is concerned in such a case but the engine as well, parts of which are apt to give or at least be permanently affeoted by an abnormal load.

The Edison Companies' Convention.

The Association of Edison Illuminating Companies held its twenty-fifth convention at the Hotel Wentworth, New Castle, N. H., August 30, 31 and September 1.

The meetings were presided over by President J. B. McCall, of Philadelphia. Interest in the proceedings was well sustained and there was a very complete attendance of the delegates at each session. All of the papers on the programme were read and elicited full discussion. The attendance was the largest in the history of the association.

The following officers were elected for the ensuing year:

President—Joseph B. McCall.
Vice-President—D. L. Huntington.
Treasurer—Alex Dow.
Secretary—E. A. Leslie.
Executive Committee—Samuel Insull, John W. Lieb, Jr., C. L. Edgar, L. A. Ferguson and G. W. Brine.

Mr. Millard B. Hereley, general superintendent of the Chicago Union Traction Company, has retired. Mr. R. R. Herzog, who was assistant superintendent, has succeeded him.

THE INTERNATIONAL ELECTRICAL CONGRESS.

Programme of the Different Sections and Titles of Papers to be Read.

The International Electrical Congress will convene at the Music Hall of the Coliseum, St. Louis, at 9:30 A.M., on Monday, September 12. The Music Hall is situated at Olive and 13th streets, in the City District of St. Louis.

It is intended that after the opening ceremonies the convention will immediately divide into sections, the section halls being on the second floor of the same building. The bureau of information and the offices of the secretary and treasurer will also be in the Coliseum Building. On Tuesday, Wednesday, Thursday and Friday the sections will meet on the second floor of the Coliseum from 9 A.M. to 1 P.M.

The following are the preliminary programmes of the different sections, subject to interchange modification by section officers:

SECTION A.—General Theory—Mathematical, Experimental.

Chairman, Prof. E. L. Nichols; secretary, Prof. H. T. Barnes.

AUTHORS AND TITLES OF PAPERS.

Prof. Dr. S. Arrhenius—On the Relation between the Sun's Rays and Electromagnetic Disturbances on the Earth.

Prof. Dr. Moise Ascoli—Systems of Electric Units.

Prof. Dr. Paul Drude—Metallic Conduction from the Standpoint of the Electronic Theory.

Prof. Dr. W. Jaeger—Electrical Standards.

Prof. H. Nagaoka—Magnetostriction.

Prof. J. S. Townsend—The Theory of Ionization by Collision.

Prof. J. J. Thomson—The Corpuscular Theory.

M. J. Violle—Secondary Standards of Light.

Prof. C. T. R. Wilson, F. R. S.—Condensation Nuclei.

Prof. P. Zeeman—Recent Progress in Magneto-Optics.

Dr. Carl Barus—Atmospheric Nuclei.

Prof. Howard T. Barnes—The Mechanical Equivalent of Heat Measured by Electrical Means.

Dr. L. A. Bauer—The State of Our Knowledge Regarding the Earth's Magnetism and Recent Remarkable Magnetic Storms.

Prof. D. B. Brace—Magneto-Optics.

Prof. H. S. Carhart and Prof. G. W. Patterson, Jr.—The Absolute Value of the Electromotive Force of the Clark and Weston Cells.

Prof. C. D. Child—The Electric Arc.

Dr. K. E. Guthe—Coherer Action.

Dr. A. E. Kennelly—The Alternating Current Theory of Transmission-Speed over Submarine Telegraph Cables.

Prof. E. Percival Lewis—The Electrical Conductivity of Gases.

Prof. J. C. McLennan—Radioactivity of Mineral Oils and Natural Gases.

Prof. Louis T. More—Electrostriction.

Prof. E. F. Nichols—The Unobtained Wave-Lengths Between the Longest Thermal and the. Shortest Electric Waves yet Measured.

Prof. E. L. Nichols—Standards of Light.

Dr. H. Pender—The Magnetic Effect of Moving Charges.

Prof. M. I. Pupin—Electrical Impulses and Multiple Oscillators.

Dr. E. B. Rosa and Mr. F. W. Grover—The Absolute Measurement of Inductance.

Prof. E. Rutherford—Radioactive Change.

Prof. J. Trowbridge—Spectra of Gases at High Temperatures.

Prof. A. G. Webster—Report on Recent Developments in Electrical Theory.

Dr. Frank A. Wolff—The So-called International Electric Units.

Prof. J. Zeleny—The Discharge from Points.

SECTION B.—General Applications.

Chairman, Prof. C. P. Steinmetz; secretary, Prof. Samuel Sheldon.

AUTHORS AND TITLES OF PAPERS.

Prof. E. Arnold and J. L. La Cour—The Commutation of Direct and Alternating Current Machines.

M. Andre Blondel—Calculation and Tests of Alternators.

M. Paul Boucherot—Kinetic Variations of EMF. in Dynamo-Electric Generators and its Influence on their Operation in Parallel.

Dr. O. S. Bragstad—Theory and Method of Operation of Repulsion Motors.

Col. R. E. Crompton—Standardization of Dynamo-Electric Machinery and Apparatus.

Profs. Drs. Elster and Geitel—Concerning Natural Radioactivity of the Atmosphere and the Earth.

Herr Clarence Feldmann and Joseph Herzog—The Distribution of Voltage and Current in Closed Conducting Networks.

M. Alexander Heyland—Recent Developments in Compounded Alternators with Alternating Current Self-Excitation.

W. M. Mordey—(To be announced.)

M. A. Nodon—Rectifiers.

Sir. W. H. Preece—Electricity in Ancient Egypt.

Prof. C. A. Adams—The Leakage Reactance of Induction Motors.

Mr. C. Day—Electric Motors in Shop Service.

Mr. H. W. Fisher—Sparking Distances Corresponding to Different Voltages.

Prof. E. B. Rosa, Dr. M. G. Lloyd and Mr. C. E. Reid—The Influence of Wave Shape upon Alternating Current Meter Indications.

Mr. D. B. Rushmore—The Regulation of Alternators.

Prof. H. J. Ryan—The Design of Insulators.

Dr. Clayton H. Sharp—The Equipment of a Commercial Testing Laboratory.

Prof. H. B. Smith—Very High Voltage Transformers.

SECTION C.—Electrochemistry.

Chairman, Prof. H. S. Carhart; secretary, Mr. Carl Hering.

AUTHORS AND TITLES OF PAPERS.

Geh. Reg. Prof. Dr. W. Borchers—Electrometallurgy of Nickel.

Sherard Cowper-Coles — Electrolytic Methods for the Rapid Production of Copper Sheets and Tubes.

Dr. F. Dolezalek—(Subject to be announced).

J. Sigfrid Edstrom—Electrical Extraction of Nitrogen from the Air.

Dr. H. Goldschmidt—Alumino-Thermics.

Prof. Dr. F. Haber—Electrolytic Disturbances in the Earth.

Dr. P. L. T. Heroult—Electrometallurgy of Iron and Steel.

Prof. Dr. Richard Lorenz—Electrolysis of Fused Salts.

Prof. Dr. W. Ostwald—Electrolysis and Catalysis.

Mr. J. Swinburne—Electrolytic Smelting of Sulphide Ores.

Prof. W. D. Bancroft—The Chemistry of Electroplating.

Mr. A. G. Betts and Dr. Edward F. Kern—The Lead Voltameter.

Prof. H. S. Carhart and Dr. C. A. Hulett—The Preparation of Materials for Standard Cells and Their Construction.

Dr. A. E. Kennelly and S. E. Whiting—The Present Status of the Edison Storage Batteries.

Dr. K. E. Guthe—The Silver Voltameter.

Prof. L. Kahlenberg—The Electrochemical Series of the Metals.

Prof. J. W. Richards—The Energy Absorbed in Electrolysis.

Prof. T. W. Richards—The Relation of the Theory of Compressible Atoms to Electrochemistry.

SECTION D.—Electric Power Transmission.

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AUTHORS AND TITLES OF PAPERS.

Sig. E. Bignami—Electrical Transmission Plants in Switzerland.

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Mons. Maurice Leblanc—Transmission of Alternating Currents Over Lines Possessing Capacity.

Prof. G. Mengarini—Utilization of Hydraulic Powers in Italy.

F. G. Baum—High-Potential Long-Distance Transmission and Control.

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A Subscriber Who Is Pleased.

Editor ELECTRICITY.

SIR: I have looked your paper over and find it to be all you claim for it. I think it a perfect paper in that direction. Please place my name on your subscription list, and inclosed find one dollar for same. Yours,

C. W. BURRILL.

East Saugus Mass., Aug. 17, 1904.

THE BRITISH ASSOCIATION.

(From our London Correspondent.)

The annual congress of the British Association for the Advancement of Science was held at Cambridge from August 17 to 24, the Rt. Hon. A. J. Balfour, the Prime Minister, being president.

The presidential address, which consisted of some reflections suggested by the new theory of matter, was delivered by Mr. Balfour on the evening of August 17 before a great audience of several thousands of those interested in scientific research and pursuits, including many of the more eminent of English and Contidental scientists.

As usual we are mainly concerned with the proceedings in Section G, in which some good electrical engineering papers were read and to some extent discussed. We say to some extent because it was impossible to give much time to discussing papers which were read, in many cases in full, in strict conformity with real-old-English custom. The value of the brief discussion was lessened by the fact that the speakers had but little if any opportunity of reading the papers in advance of the meeting. The president of this section was the Hon. C. A. Parsons, the inventor of the turbine of that name, and his address was primarily devoted to relating the disadvantages under which British inventors labor, and the consequent loss to themselves individually and to the world at large by the shortcomings of British patent law.

At the conclusion of this address Prof. Schroter presented Mr. Parsons with the Grashof gold medal and diploma of the German Society of Engineers—said to be the largest society of the kind in the world, with 19,000 members—in recognition of his valuable work in the invention of the steam turbine.

Three papers on subjects connected with the gas engine were discussed together at some length. They were: "Flame Temperatures in Internal Combustion Motors," by Mr. E. Dugald Clerk; "On the Specific Heats of Gases at High Temperatures," by Prof. H. B. Dixon; and "Exhaust Gas Calorimetry," by Prof. B. Hopkinson. Mr. J. W. Hayward read a communication on "The Effect of Receiver Drop in a Compound Engine," and a paper on "Superheated Steam: Throttling and Other Experiments," by Mr. A. H. Peake, was taken as read.

Mr. A. A. Campbell Swinton brought forward the subject of "Electricity from Water Power," and gave details of some schemes which are in process of carrying out just now in Wales and Scotland. He had collected statistics relating to the use of water power throughout the world and placed the amount of power being actually used for electrical production at more than 2,000,000 hp.

A special paper by Dr. J. A. Fleming, was entitled "Electric Waves Along Spiral Wires, and on an Appliance for Measuring the Length of the Waves Used in Wireless Telegraphy."

It has been arranged that next year's meeting of the Association shall be held in South Africa, and in 1906 York will be the place of meeting.

Clark Caryl Haskins Dead.

Clark Caryl Haskins died from inanition, at his residence in Chicago on Saturday last. He was born in Buffalo in 1827, and was the son of R. W. Haskins, a scientist and writer. Mr. Haskins was well-known in the electrical world as an inventor and writer. In 1844 he is said to have sent the first telegraphic message that ever passed between two countries, wiring it from Buffalo to Queenstown, Canada. His most notable achievement was evolving the multiple switchboard, now used for telephones all over the world, which makes it possible to operate any number of lines from the same exchange.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 30, 1904.

Electric Railways and Appliances.

768,634. Electric Railway-Brake. Levi L. Stamm, Almond, N. Y., assignor to Bartz, Wygant & Brown, Incorporated, Hornellsville, N. Y. Filed Dec. 8, 1903.

768,674. Trolley for Electric Cars. Lewis M. McBride, Denver, Col. Filed Jan. 25, 1904.

768,789. Trolley-Pole Controller. Martin O. Dolson, Los Angeles, Cal. Filed Dec. 23, 1903.

768,863. Hanger for Trolley-Wires. Augustus Neubert, Elizabeth, N. J. Filed Dec. 10, 1903.

768,868. Automatic Electric Controlling System. Wilhelm Stockmeyer, Frankfort-on-the-Main, Germany. Filed March 18, 1902.

768,959. Trolley-Wheel. Frederick Strall, Rochester, N. Y., assignor of three-fourths to Alfred Green, George W. Hooper and Charles L. Hooper, same place. Filed June 1, 1903.

769,070. Trolley. Lindey F. Forrester, Foxboro, Mass. Filed Jan. 16, 1904.

769,085. Trolley-Retriever. William W. Hoffman and Francis W. Powers, West Lafayette, Ind., assignors to the Electric & Steam Railway Company, same place. Filed Oct. 19, 1903.

769,086. Trolley-Harp. William W. Hoffman, West Lafayette, Ind., assignor to the Electric & Steam Railway Supply Company, same place. Filed March 24, 1904.

Electric Lights and Appliances.

768,614. Device for Protecting Carbon Filaments for Incandescent Electric Lamps. Albert W. W. Miller, South Orange, N. J., and George P. McDonnell, St. Louis, Mo., assignors to the American Electric Company, East Orange, N. J. Filed July 3, 1903.

768,745. Electric-Arc Lamp. Melville F. Goodrich, Newton, Mass. Filed Aug. 13, 1903.

768,847. Electric Lamp. Elias L. Elliott, New York City, assignor to the Illuminating Engineering Company, same place. Filed June 5, 1903.

769,003. Manufacture of Electrodes of Arc-Lamps. Maurice Lilienfeld, Berlin, Germany. Filed March 3, 1903.

769,094. Electric-Lighting System for Cars. Herman Kreusler, Brooklyn, N. Y. Filed Nov. 28, 1903.

Electrical Machinery and Apparatus.

768,584. Automatic Synchronizing Apparatus. Milton C. Canfield, Cleveland, O. Filed Aug. 3, 1903.

768,597. Turbine-Bucket. Henry Geisenhoner, Schenectady, N.Y., assignor to the General Electric Company. Filed Aug. 21, 1902.

768,610. Electric Controller. John Lindall, Boston, Mass. Filed Jan. 13, 1904.

768,616. Circuit-Interrupter. George P. McDonnell, St. Louis, Mo., assignor of forty-nine per cent. to Oscar E. Plochman and Richard F. Spencer, same place. Filed May 10, 1902.

768,630. Electric Accumulator. Constantin de Sedneff, Paris, France. Filed July 28, 1902.

768,687. Electric Sparking Igniter for Explosive-Motors. Lucius J. Phelps, Stoneham, Mass., assignor to the Phelps Motor Vehicle Company, same place. Filed April 9, 1903

768,711. Controller for Electric Motors. Frank C. Watkins, Vallejo, Cal. Filed Nov. 20, 1903.

768,738. Motor-Generator. Gano S. Dunn, New York City. Filed April 22, 1904.

768,754-755-756. Insulating Electric Conductor. Isidor Kitsee, Philadelphia, Pa. Filed April 26, 1902; June 19, 1902, and Oct. 7, 1902.

768,843. Armature. James Burke, Berlin, Germany, assignor to the Burke Electric Company. Filed Nov. 2, 1899.

768,883. Power-Transmission Device. Peter N. Nelson, Galesville, Wis. Filed May 10, 1904.

768,934. Metering System. Thomas Duncan, Lafayette, Ind. Filed June 6, 1904.

768,937. Apparatus for Rectifying Alternating Currents. Charles M. Green, Lynn, Mass., assignor to the General Electric Company. Filed Oct. 25, 1900.

768,941. Circuit-Breaker. Edward M. Hewlett, Schenectady, N.Y., assignor to the General Electric Company. Filed June 29, 1901.

768,982. Electric Meter. Thomas Duncan, Chicago, Ill. Filed July 11, 1911.

768,957. Electrical Measuring Instrument. Homer C. Snook, Philadelphia, Pa., assignor to the Roentgen Manufacturing Company, same place. Filed June 17, 1904.

769 057. Electrical Choke-Coil. George S. Carson, Iowa City, Ia. Filed March 30, 1904.

769,090. Revolving Field for Electric Generators or Motors. William A. Johnson, Toronto, Canada. Filed March 5, 1903.

769,098. Starting Device for Alternating-Current Induction Motors. Hans S. Meyer, Rugby, Eng., assignor to the General Electric Company. Filed Nov. 7, 1902.

769,111. Lever-Locking Device for Electric Starting-Boxes. George W. Pierce, Butte, Mont. Filed March 23, 1903.

769,116. Electric Switch. George J. Schneider, Detroit, Mich., assignor to the American Electric Heater Company, same place. Filed Aug. 4, 1903.

Telephones and Telephone Apparatus.

768,617. Supervisory Signal Apparatus for Telephone Switchboards. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed Jan. 2, 1904.

769,064. Contact for Telephone or Like Circuits. Walter A. W. E. Hjorth, Stockholm, Sweden, assignor to the Elektromilitara Aktiebolaget, same place. Filed July 17, 1903.

769,125. Telephone Substation Outfit. Ernest E. Yaxley, Chicago, Ill. Filed Dec. 28, 1903.

Miscellaneous.

768,581. Electrical Apparatus. Fred Burks and Charles Rohlfs, Buffalo, N. Y. Filed Jan. 28, 1904.

768.667. Electrical Counting Apparatus. John A. Kray, Lancaster, Pa., assignor of one-half to Daniel Rothenberger, same place. Filed Dec. 31, 1902.

768,721. Electrode for Therapeutical Purposes. William B. Bassell, Columbus, O. Filed April 4, 1904.

768,728. Electrically-Actuated Gramophone. Theodore Birnbaum, Berlin, Germany. Filed May 5, 1902.

768,764. Resistance-Sheet for Electric Heaters or Rheostats George I. Leonard, Pasadena, Cal. Filed Sept. 9, 1903.

768,778. Wireless Telegraphy. Homer C. Snook, Philadelphia, Pa., assignor, by mesne assignments, to the American De Forest Wireless Telegraph Company. Filed Oct. 23, 1902.

768,908. Electric-Time System. David Perret, Neufchatel, Switzerland. Filed March 31, 1904.

768,953. Recording Apparatus for Electric Waves. Lewis T. Robinson, Schenectady, N.Y., assignor to the General Electric Company. Filed Nov. 11, 1901.

768,995. Electric-Arc Furnace. Antoine H. Imbert Grand Montrouge, France, assignor to the Societe de Metallurgie, Electro-Thermique, Paris, France. Filed March 3, 1904.

THE TELEPHONE WORLD.

Ohio Independent Telephone Men to Fight Bell.

The first district organization of the Independent telephone interests of Ohio has been completed. The Independent telephone companies that comprise district No. 1 have selected an executive committee.

This organization is an offensive and defensive alliance against the Bell telephone interests. In the organization the State has been divided into nine districts, each presided over by a vice-president.

The meeting was attended by 65 managers of Independent companies in the district which comprises the counties of Ashtabula, Cuyahoga, Lorain, Erie, Huron, Medina, Lake, Geauga and Trumbull.

The object of the organization is outlined in the following extract from the report:

"The plan we propose is as follows: Have each of the nine districts thoroughly organized, membership to be composed of bona fide Independent companies, who have no affiliations with any other competing company, each company to be entitled to a vote for each 100 telephones or 100 miles of toll lines they may have in their system, the districts to elect annually one delegate to the State convention, the State association to consider the larger subjects that may be of interest to the Independent telephone interests of the State. In case this plan of organization should meet with the approval of a sufficient number of the Independent telephone companies of the United States, each State could then be organized along the same line. In this way the Independent telephone interests of the United States would be a unit."

One point emphasized by all the members of the association is the necessity of at once standardizing the equipment of the several companies. It is thought that with the centralization of the companies this can be forced. It was pointed out by the speakers that in no other public utility was there such a divergence in equipment as the telephone systems of this country.

A raise in the rate from 5 to 10 cents for the use of the telephone between Elmwood, St. Bernard and Carthage, O., and the towns up the valley, Wyoming, Glendale, etc., is causing a lively war at present between the residents of those villages and the Cincinnati & Suburban Telephone Company. As the merchants of these villages say that this raise will make them lose a great deal of their trade, they threaten to have their telephones taken out unless the old price is retained. To settle the matter with the telephone company the residents of these villages have appointed a committee.

It is reported that the Northern Pacific will shortly equip its main line with the telegraphone system, combining in its operation both the telegraph and telephone.

The York telephone line is being extended from Red Lion to Springvale, Pa., on the line of the Maryland & Pennsylvania Railroad.

C. A. Mann has purchased the telephone exchange at Moulton, Ia., and improvements will be made.

Toronto Wants Offers for Telephone System.

Toronto will receive sealed offers up to noon on Saturday, October 1, for the installation and operation of a telephone system in that city upon terms and conditions which may be obtained from the city clerk, city hall, Toronto. All bids must be accompanied by a cash deposit or marked check for the sum of $5,000, and made payable to the order of the city treasurer. This deposit is required to guarantee to the city the fulfillment of the accepted bid of any party in accordance with the contracts and terms of the specifications. Those desiring to submit bids should address them to the mayor, Thomas Urquhart, who is chairman of the board of control. To be certain that the bids have been delivered they should be sent registered. It should be understood by all parties participating in this matter that the city does not bind itself to accept any tender.

Kicking on Bell 'Phone Service.

A great deal of dissatisfaction exists in Springfield, Tenn., growing out of the poor service now being furnished by the Cumberland Telephone Company. The rate there is largely in excess of that charged in other towns of that class, and it is doubtful if any service is as poor. Local capitalists are trying to get the Home Company, a strong Independent company of Hopkinsville, to put in an exchange at Springfield.

The Woodston Mutual Telephone Company has been formed for the purpose of building two lines into Stockton, Kan. One is a commercial and the other a party line. Arrangements are being made to co-operate with the Stockton and Webster exchanges and rural lines.

Canastota, N. Y., will have a home telephone system. The village board unanimously passed a resolution to the effect that a franchise shall be granted to the Canastota Telephone Company, soon to be incorporated, probably on a capital of $15,000. Charles J. Wood, of Utica, is the promoter of the new company. E. Saltsman and John W. Souter are among the men of Canastota who are aiding the project.

Dr. Thomas J. Rhoades has been elected president of a new telephone company organized at Pottstown, Pa., which will construct a line to that place and Birdsboro. It is the intention to connect at Reading with the lines of the Consolidated Telephone Company.

The Burlington, Rochester & Kansasville Telephone Company, of Rochester, Wis., by George W. Rountree, president, and George W. Waller, secretary, has filed an amendment increasing the capital stock from $5,000 to $10,000.

A certificate of incorporation was recently issued by the Illinois Secretary of State to the St. Joseph Telephone Company. Its capital stock is $18,000, and incorporators, N. C. Hoyt, U. G. Glasscock and O. C. Boggs.

The Farmers' Mutual Telephone Company of Lac qui Parle County, Minn., has been incorporated, its capital stock being $200,000.

Bids Wanted for Telephone Cable.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until September 27 for furnishing the Mare Island and Puget Sound Navy Yards with a quantity of telephone cable and a motor generating set. Blank proposals will be furnished upon application to the Bureau at Washington or to the Navy pay offices in San Francisco and Seattle. Wash.

The Delaware & Schoharie Telephone Company has filed papers of incorporation with the Secretary of State at Albany, N. Y. The company proposes to establish a line from Stamford, Delaware County, to South Jefferson, Jefferson, Blenheim, Ruth, Gilboa, South Gilboa and other places in Schoharie County. The capital stock is $2,000. The directors are H. P. Hubbell and E. W. Landon, of Stamford, and E. P. Jones, R. H. Champlin, of Ruth, and others.

At the meeting of the Independent telephone companies of Wapakoneta, O., embracing the counties of Marion, Wyandot, Hancock, Putnam, Paulding, Van Wert, Mercer, Allen, Auglaize and Hardin, the following officers were elected: Mr. Matheny, president; D. A. Clark, of St. Marys, secretary. The aim of the association is to have a firmer union of the Independent telephone interests for the purpose of promoting uniformity of operation.

The board of public works, of Oneida, N. Y., has granted a franchise to the Rome Home Telephone Company for a toll line through that city from the east. The company is to maintain a toll station at Oneida, string not more than four wires on its poles, and allow the city 50 free calls a year. It is expected that the company will shortly apply for a franchise to do a local business.

The Hollidaysburg, Pa., borough council lately discovered that the Bell Telephone Company was using streets without any authority. Orders were isssued for the removal of the property at once. This is a counter move to prevent the raising of rates, as the company had announced.

Telephone Incorporations

The Marilla Telephone Company, Marilla, N. Y. Capital stock, $3,000. Directors: Howard Adams, J. G. Bartoo and William Bates, of Marilla.

The North Creek Telephone Company, North Creek, N. Y. Capital stock, $10,000. Incorporators: Celia A. Pereau, W. T. Campbell and James L. Fuller, all of North Creek.

The Farmers' Union Telephone Company, Kirkland, Ill. Capital stock, $2,500. Incorporators: William Van Wert, John Paulson and W. N. Thompson.

The North Penobscot Telephone Company, Bangor, Me. Capital stock, $5,000. Officers: President, H. T. Osgood, Kingman; treasurer, W. A. Blanchard, Carroll; clerks, C. E. Tolman and C. R. Bishop, with W. H. Martin Kingman and J. W. Lindsey, Carroll.

The Union Telephone Company, Point Peninsula, N. Y. Capital stock, $1,000. Directors: F. M. Wiggins, A. R. Washburn and M. R. Holbrook, of Point Peninsula.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Afton, Ia.—This town has voted electric light bonds to the amount of $4,500.

Ameca, Mex.—A. Reyes, of Guadalajara, has entered into an agreement with the municipal authorities of this city, for the establishment of an electric lighting and power system. Mr. Reyes operates an alcohol factory here in which electricity will also be employed.

Belvidere, N. J.—The council will receive bids this month for lighting this town with electricity.

Biggs, Cal.—H. Martines has been awarded the contract to supply this town with electricity.

Breese, Ill.—The electric light question is being agitated and the indications are that the matter will be taken up and a light plant established here within the next year.

Carmi, Ill.—At a recent special meeting of the city council an ordinance was passed authorizing the city authorities to issue bonds to the extent of $1,500, for the purpose of erecting a system of alternating street lamps, and the necessary appliances for the same.

Chicago, Ill.—The Van Buren Electric Light Company of this city was lately incorporated with $50,000 capital, by H. D. Maize, T. F. Low and H. M. Dewar.—The Seneca Electric Company of this city was also incorporated with $10,000 capital stock to operate an electric light, heat and power plant. C. C. Travis, C F. Travis and R. E. Travis are the incorporators.

Coden, Ala.—F. B. Price, of Glenwood, is interested in an electric light scheme to light this place and Bayou Labatre; the plant will be erected half way between the two places.

Columbia, Miss.—The Board of Trade of this city is interested in the establishment of an electric light plant here.

Hanover, Pa.—The town council has approved an ordinance granting permission to the Hanover Electric Power & Heating Company to erect an electric lighting plant. H. N. Stokes is president.

Hood River, Ore.—H. L. Vors, a capitalist and promoter from New York City, has secured an option on the property of the Hood River Electric Light, Water & Power Company, and is investigating the situation here with a view to purchasing. It is understood that Mr. Vors thinks very favorably of the property, and it is given out that should the deal be closed, it means a system of fire protection for the city, an increased water supply and an improved light service.

La Belle, Mo.—The citizens of this place are agitating the question of building a municipal electric light plant.

Leslie, Mich.—The electric light plant here, owned by a stock company, was lately destroyed by fire. The dynamos, shafting, belting, etc., were ruined.

Lincoln, Neb.—Members of the city council have decided to erect the new muni ipal electric lighting plant.

Litchfield, Ill.—The citizens have voted a 75-year franchise to D. Davis, for the construction and maintenance of a gas and electric light plant.

Little Falls, N. Y.—I. N. Lovenheim, whose electric lighting plant was destroyed by fire on Mill street recently, has made a proposition to the business men of this city to assist him in rebuilding the Consumers' Electric Light Works.

Marquette, Mich.—The $15,000 of bonds which the electors of the city recently authorized issued for the purpose of procuring funds with which to rebuild the electric light plant, destroyed by fire some time ago, have been sold.

Maryville, Tenn.—A company composed of J. A. Goddard, Jesse Groner, T. F. Cooper, Joe and Sam Walker, Major McTeer and others, have purchased the Rockford cotton mill property, and have applied for a charter for an electric light and power plant at the same place, to be known as the Rockford Electric Company, with a capital stock of $50,000. The purpose is to utilize the water power at that place in furnishing light and power for this city and elsewhere, if desired.

Meeteetse, Wyo.—The council has granted a franchise to A. C. Thomas for an electric light and power plant. The preliminary work is under way.

Monticello, N. Y.—The Monticello Electric Light & Power Company will erect a new power house near the station now in operation.

Mt. Vernon, Ind.—The Mt. Vernon Electric Light & Power Company has been incorporated with $5,000 capital stock by J. H. Purdy and H. R. Lynn.

Oklahoma City, Okla.—F. A. Knock, of Wichita, Kan., has asked the city council for a franchise to establish an electric light plant here.

Packwood, Ia.—The citizens of this place are agitating the question of erecting an electric light plant.

Sodus, N. Y.—It is probable that this village will be lighted by electricity supplied by the Rochester Railway Company.

Tremont, Ill.—F. O'Mera, of Minnesota, has bought the electric light plant of B. C. Koch & Co., and will take charge October 1.

Utica, Miss.—The people here have voted a $10,000 bond issue to build an electric light plant and waterworks

Vernon, B. C.—A proposition is now before the city council from a company offering to supply power to be developed at Shuswap Falls for the electric light plant here

Vincennes, Ind.—The Vincennes Light & Power Company was lately granted permission to place a line of poles in this city upon which to string electric light wires.

Waukegan, Ill.—The North Shore Electric Company, of which S. Insull is president, and which supplies electric light and power to the territory from and including Evanston and this city, has decided to erect a big central power house on the lake front here to supply this region.

Wausau, Wis.—The city council has voted to build a municipal electric lighting plant and buy the current from the Wausau Electric Company at the rate of 2.5 cents per kilowatt hour.

Wayne, Mich.—An election will be held here for the purpose of voting on the proposition to bond the village in the sum of $8,000 for the establishment of an electric light plant.

West Chester, Pa.—J. M. Entriken has been awarded the contract for the erection of a new electric light plant here.

Wheaton, Ill.—The Dupage County Electric Light & Power Company of this city has been incorporated with $30,000 capital stock. E. C. Faber, D. J. Peffers and E. C. Flenner are the incorporators.

STREET RAILWAYS.

Anderson, S. C.—The Anderson Traction Company, which is building the street car line, decided to erect a power plant of its own here.

Beatrice, Neb.—There is talk of this town having an electric road.

Covington, Ky.—Bids will be received for the privilege of constructing a single track of railway operated by electricity along the streets in the town of Central Covington. Address Frank Staggonborg, town clerk.

Galion, O.—A new electric line is to be erected between here and Marion. C. W. Bechtel is president of the new company.

Lakewood, N. J —Engineer Segoine, of Point Pleasant, has been engaged for several days past in surveying the route for a trolley road from Lakewood to Spring Lake. The enterprise is backed by a syndicate of Spring Lake capitalists, some of whom are interested in the New Monmouth hotel at that place.

La Porte, Ind.—The Chicago & South Shore Railway Company will reorganize and be called the La Porte & Michigan City Traction Company with a capital of $350,000.

Libby, Mont.—An electric line is to be constructed from here to the mines south.

Montesano, Wash,—An ordinance has been passed granting to J. R. Wedell, A. S. Caton and W. Haycox, a franchise to construct and operate an electric line through this city.

San Juan, Porto Rico.—The Porto Rico Railway, Light & Power Company, the assignees of the franchise granted to the Vandegrift Construction Company of Philadelphia, to construct and operate an electric railway between here and Ponce, a distance of about 70 miles, has started work on the grading from Rio Piedras towards Caguas, passing near Trujillo Alto The executive committee has amended this franchise and the company is now allowed to pass through the town of Rio Piedras. The plans and profiles for the line from this city to a point between Caguas and Rio Piedras have been approved by the bureau of public works.

Wichita Kan.—The Arkansas Valley Interurban Railway Company has increased its capital stock to $1,500,000, and the charter provides for a network of trolley lines connecting Hutchinson, this city, Winfield and several towns.

POWER PLANTS.

Fremont, Neb.—W. L. C. Kenyon is the promoter of the project here to build a large power plant.

York, Pa.—An ordinance has been passed granting to the Edison Electric Light Company of this city the right to construct and maintain poles, wires, lines and fixtures for the transmission and distribution of electric power and current for electrical purposes over and upon the public highways of the borough of Manchester, York County. H. A. Kauffman is president of the council.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12⅝@12⅞c.; casting, 12⅜@12½c.

Application has been made to the New York Stock Exchange to list $5,000,000 additional first refunding mortage 4 per cent. bonds of 2002 by the Brooklyn Rapid Transit Company.

The Chicago City Railway Company has declared the regular quarterly dividend of 2¼ per cent., payable September 30. Books close September 12 and reopen September 18.

The Mercantile Trust & Deposit Company of Baltimore has sold its holdings of $739,000 Georgia Railway & Electric Company consolidated mortgage 5 per cent. bonds to parties in Boston.

W. B. Royce, of Middletown, N. Y., has been appointed receiver for the Middletown-Goshen Electric Railway Company. The receivership is due to mortgage foreclosure proceedings instituted by the Farmers' Loan & Trust Company of New York.

The Water Committee of the city of Richmond, Va., which has been considering the question of damages by the rails of the Virginia Passenger & Power Company through electrolysis to the city's water mains, has issued a demand that the matter be settled by arbitration or taken to the courts. It is charged on behalf of the city that fully $70,000 damage has resulted thus far from electrolysis.

The Brooklyn *Eagle* says that Brooklyn Rapid Transit affairs are still dominant in the home security market and that quite a number or local investors are becoming impressed with the merits of this issue, especially for a "long pull," and several instances are known where shrewd men of capital have stored away some of these certificates, both stocks and bonds, in strong boxes with the expectation not to touch them for several years. At that time, these men claim, a handsome profit will be possible, and one enthusiast holds positive opinions that within five years the convertible 4 per cent. bonds will be valuable directly on account of this convertible privilege. This privilege, it is added, will be of even greater value before it expires, in July, 1914.

The New York City Railway Company, as lessee of the Metropolitan Street Railway system, last week made public its annual report. Gross earnings were $21,485,006, a decrease of $64,539, and the operating expenses were $12,127,855, an increase of $738,746. Both decrease in gross earnings and increase in operating expenses President Vreeland charges to the length and severity of last winter. Added to those losses were increased expenses for accident claims. Deducting all expenses and fixed charges there remained a deficit of $1,396,770. The number of passengers carried was 432,475,170, a decrease from last year of 1,133,354. The number of transfers issued increased, however, by nearly 9,000,000. According to the report the road still uses 4,036 horses for the operation of its lines in the Borough of Manhattan. The report gives more details of operation than the company has published heretofore. It does not appear in the statement in any direct manner to what extent the Metropolitan Securities Company was called upon to pay the 7 per cent. annual dividend which the Securities Company guarantees on Metropolitan Street Railway stock. In the assets of the New York City Railway Company appears the item, "Metropolitan Securities Company subscription to the New York City Railway Company Securities, $8,052,000." A year ago the same item placed the amount at $10,202,000, showing a discrepancy for the year of $1,150,000.

ELEOTRIOAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Noon price Sept. 6
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	154⅞
Metropolitan Street Railway	119¾
Metropolitan Securities	88½
Ninth Avenue	195
Third Avenue	125
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	237
Brooklyn Rapid Transit	55⅞
Public Service Corporation (New Jersey)	98
Philadelphia.	
Consolidated Traction of New Jersey	70
Philadelphia Traction	98⅞
Union Traction	54¼
Boston.	
Boston Elevated	150½
Massachusetts Electric Companies, com	15
do. do. do. pref.	62½
West End Street, com	91½
do. do. do. pref.	111¼
Chicago.	
City Railway	168
North Chicago	71
Union Traction, com	7½
do. do. pref.	36½

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Noon price Sept. 6
New York City.	
Allis-Chalmers, com	11½
do. pref.	50½
Electric Boat, com	40
do. do. pref.	75
Electric Lead Reduction	¾
Electric Vehicle, com	9¾
do. do. pref.	14
Westinghouse, com	160¼
do. pref.	180
General Electric	169
Boston.	
Edison Electric Illuminating	263
General Electric	166
Westinghouse Electric & Mfg., com	80
do. do. do. pref.	90
Chicago.	
Chicago Edison	145
National Carbon, com	35¼
do. do. pref.	107
Philadelphia.	
Electric Company of America	9¼
Electric Storage Battery, com	61
do. do. do. pref.	61

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Noon price Sept. 6
Boston.	
American Telephone & Telegraph Company	138
Western Telephone Company	14
New England Telephone Company	123¾
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	180
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	90¾
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..

MISCELLANEOUS STOCKS.

Name.	Noon price Sept. 6
Otis Elevator Company	35
Consolidated Car Heating	64
Standard Underground Cable	200

ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

Under Water Signaling.

Signaling under water by means of sound waves, which has been referred to in these columns several times as having been successfully accomplished near Boston, is now being tried in connection with submarine boats. The experiments were conducted last week in Narragansett Bay and are said to have been quite satisfactory as initial trials.

The submarine torpedo boat "Shark" was equipped with the necessary receiving apparatus, and it is stated that the position and course of the torpedo boat "Stiletto" was determined on board the submarine while submerged by the beat of the "Stiletto's" screw.

It was found that neither depth nor pressure was a disadvantage in the matter of using the signal. The gunboat "Peoria" is to be equipped with the apparatus and then the development of a system of communication for use in the navy will be begun in earnest.

The experiment opens a wide field of possible usefulness. Equipped with the system, submarine boats could make attacks in pairs or in groups, for having the means of determining at any time their relative positions, there would be no danger of a collision as there would be without any method of communication.

* * *

Electric Trunk Line Railroads.

There is an old saying that "coming events cast their shadows before," and perhaps no event so thoroughly exemplifies the truth of this statement as the contracts closed by the leading steam roads of the East—the New York Central and the Pennsylvania—for the electrical equipment of their New York termini with the direct purpose in view of facilitating the transaction of their enormous business and meeting the public demand for greater safety and hygienic excellence.

Yet the fact that only the terminii will be equipped is significant. It is a confession on the part of the steam roads of the advantages of electricity for railroad purposes. On the other hand it might be regarded as a tacit admission on the part of our electrical engineers of the practical impossibility of extending great trunk lines any further.

Electric roads belong to the field of power transmission problems, although each is distinct from the other. The limitations of power transmission may be expressed in terms of electromotive force. The alternating current is therefore the means of solving the problem where great distances are concerned.

Steam roads through tunnels within city limits are one of the greatest abominations and risks the public have been forced to submit to; and it is strange in view of the time-proven advantages of electric traction from an economic and practical standpoint that conservatism has so long held sway over what may easily be considered in this respect the best interests ot the capitalist as well as the community at large.

There are two well defined methods of electric traction in use at present whose advantages have been tested so thoroughly that no doubt remains as to their value as a precursor of all contemplated extensions of electric roads. These systems are the overhead trolley and third rail. Within the limits of Greater New York both systems have been and are receiving the severest tests to which they could possibly be exposed. As far as the overhead trolley is concerned little need be said, as its flexibility and practicability make it

essential to the success of every growing center of population.

But as regards the third rail, what are its possibilities in the light of modern progress? Is it limited to the overhead structure or can it be installed with safety over long stretches of deserted country? The point involved in this argument is not so much the question of "what are the mechanical appliances required," but what means can be employed to supply power over long stretches of road with reliability and economy. The system is one thing, the method another. The power transmission problem must be definitely solved first, and then will follow the crystallization of this idea as far as copper and steel will allow. A series of recently reported successes in experiments with alternating currents for railroad work leads us to the belief that another great change is about to be heralded in future trunk lines, and that, it is almost unnecessary to state, is in the use of electricity for transcontinental railway lines. A belt of power stations developing high tension currents must in the future be regarded as among the necessary accessories of any great prospective trunk line. It is in all respects the greatest problem the electrical engineer has had to confront; yet it is but the logical consequence of all that has preceded it.

* * *

Cheap Electric Power for Colorado.

Advices from the West state that a company was organized some time ago for the purpose of furnishing cheap electric power in southern Colorado. The undertaking involves a rather novel engineering feat. Two or three rivers are to be lifted bodily, so to speak, from their beds and transferred to canals, which will feed an immense reservoir. From this reservoir the water will be carried through another canal and dropped through great pipes over the edge of a precipice 1,000 feet high. The power house in which the current will be generated will be situated at the foot of the precipice. Ultimately it will have a capacity of about 40,000 hp.

The site of the power house is about twenty-four miles from Silverton.

The initial cost of the undertaking, it is claimed, will approximate $1,000,000, while the ultimate plan will involve an expenditure of about $3,000,000. When the project is completed it is expected to revolutionize things in southern Colorado. With an abundant supply of cheap power many enterprises can be carried through successfully which hitherto have been blocked by the high cost of power when obtained from steam. From the power house at the foot of the precipice current will be carried to the surrounding country. If the results come up to expectations a second power house will be established a few miles to the south.

The generators will be of the three-phase type and will operate at 300 revolutions per minute. The current will be transmitted at a pressure of 50,000 volts and will be transformed down at the towns and mining centers to whatever voltage is required.

Surveys have been completed for the rights of way for the transmission lines, which will reach all of the principal mining sections in the San Juan district. These lines will extend into San Juan, Ouray, Hinsdale, La Plata and Montezuma counties. In addition to mining purposes, the company expects to furnish current for lighting all of the principal towns in the district, and also to the large smelter of the American Smelting and Refining Company at Durango.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Colorado Springs, Col., is making an active effort to secure the 1905 convention of the National Electric Light Association.

The New York Civil Service Commission announces general examinations to be held October 8, including the following positions: Electrical engineer, State Architect's office; heating engineer, State Architect's office; library assistant in sociology, State Library; assistant State geologist and marine engineer.

The fifth International Electrical Congress is now in session at St. Louis. A report of the proceedings will be found in the next issue of ELECTRICITY.

All records in overland wireless messages were broken Saturday when the De Forest Wireless Telegraph Company communicated from Chicago with the St. Louis Exposition, a distance of over 300 miles. Heretofore the overland record has been 107 miles.

To-day (Wednesday) is "Electricity Day" at the World's Fair. Prof. W. E. Goldsborough of the Department of Electricity and his assistants have arranged for a fine electrical display. In the Grand Basin adjoining the Palace of Electricity will be anchored six floats with special electrical features. One commemorates the twenty-fifth aniversary of the commercial development of the incandescent lamp; one shows a wireless telegraph station; another X-ray phenomena, etc. The Palace of Electricity and the bridges leading to the island will be decorated with flags and special banners. In the evening there is to be an automobile parade. Inside of the building a reception is to be given to the members of the International Electrical Congress and the visiting electrical engineers. On the north side of the Palace of Electricity along the lagoon, will be a high-tension line connected to a 100 kw. transformer with a secondary potential of 500,000 volts. This will be in operation showing the spectacular effects of high potential discharges.

Anticipating the use of electricity as a means of motive power, the New York, New Haven & Hartford Railroad Company is now equipping its passenger cars with storage batteries, which will furnish light for all trains between New York and Boston. Freedom from danger of fire in case of accident is given as the chief cause of installing the new method of illumination, but the advantages of electricity for brilliancy and steadiness of the lights, lack of heat and odor, and the fact that it may be split up into small units and placed in berths and other desired places have also been considered by the officials of the railroad in making the change.

It is understood in street railway circles that a movement is under way to purchase and control twenty different trolley roads in various sections of Massachusetts and northern Connecticut. This will also include the construction of a large number of amusement parks in connection with the electrical enterprises. The United Gas Improvement Company, whose corporation is considered to be in control of the Connecticut Railway & Lighting Company's network of roads in that State, is said to be largely interested in the negotiations. The purchase of lines and the construction and improvement of parks will involve an expenditure of some $7,000,000.

A dispatch from London says that the Ceylon mineralogical survey report gives details of the discovery of a mineral existing in small black cubical crystals in the refuse of the gem washings at Belangoda. The principal constituent is thorium oxide, of which there is present more than 75 per cent. The mineral appears to be new, and it is suggested that the name of thorianite be given to it, as it is radio-active. It is expected that it will be an important source of radium, and the radio-active earths will probably furnish helium.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Continued from page 134.*)

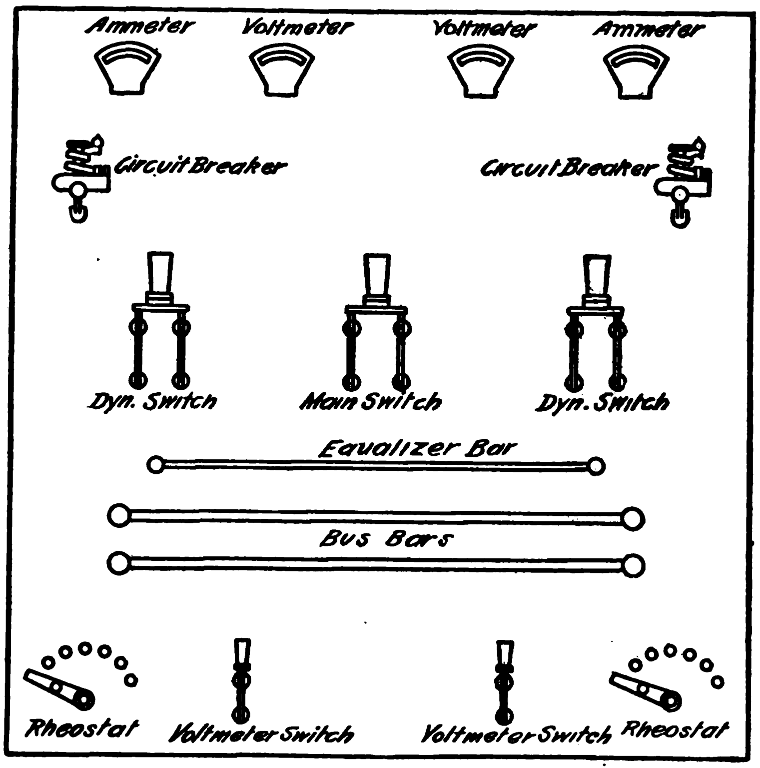
Switchboards.—The immense number and variety of the switchboards employed for electric light and power purposes for both alternating and direct current, require some classification with regard to the character of the lighting as well as the type of generator employed. The following headings may prove convenient in this respect:

SWITCHBOARD DESIGN.

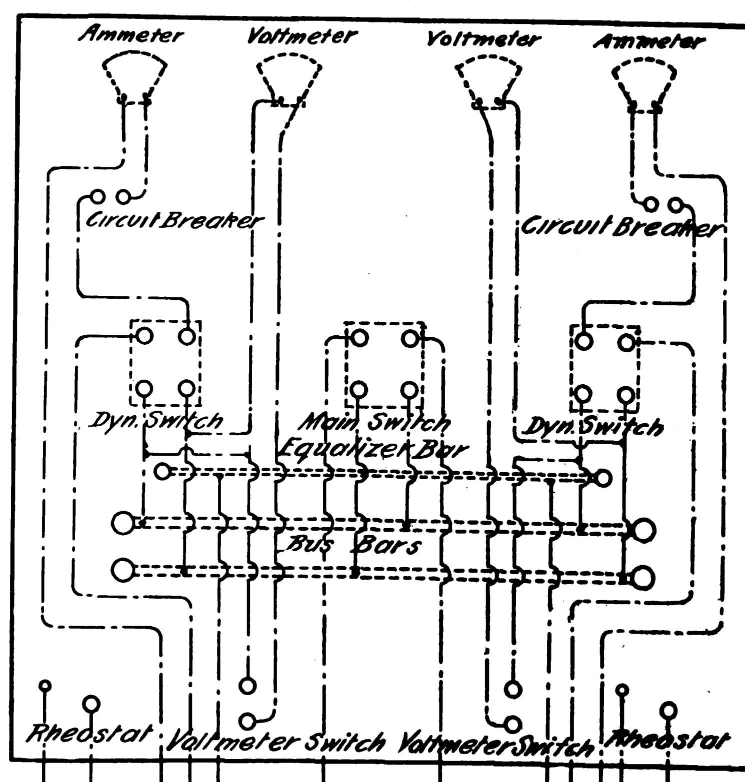
Character of generators.	*Character of lighting.*
One shunt wound dynamo.	Low tension arc and incandescent.
Two or more shunt wound dynamos.	Low tension arc and incandescent.
One compound wound dynamo.	Low tension arc and incandescent.
Two or more compound wound dynamos.	Low tension arc and incandescent.
Two or more shunt wound dynamos connected for the three-wire system.	Low tension arc and incandescent.
Two or more shunt wound dynamos connected for a combination two and three-wire system.	Low tension arc and incandescent.
One or more series dynamos each with separate circuit.	High tension arc lighting.
One alternator single phase.	Low tension arc and incandescent.
Two or more alternators single phase.	Low tension arc and incandescent.
One or more alternators two or three phase.	Low tension arc and incandescent.

The last class of generators are employed for power transmission at exceedingly high pressures and in this respect they are better known than as generators for electric lighting.

To lay out the design of a switchboard, it is absolutely necessary to become familiar with all the requirements of practice and the apparatus employed for that purpose. The low tension, direct current apparatus differs essentially from the high tension, direct and alternating current. The higher departments of switchboard design call for an intimate knowledge of the subject, and the proper protection and control of circuits and the care of the generator, whether direct or alternating, is largely dependent upon the amount of skill shown in the construction of the switchboard. A variety of technical works are at the command of the reader and systematic visits to large power stations will soon develop a familiarity with the subject which will show the relationship existing between station management and switchboard design.



Front View of Switchboard of Two Compound Wound Dynamos in Multiple.



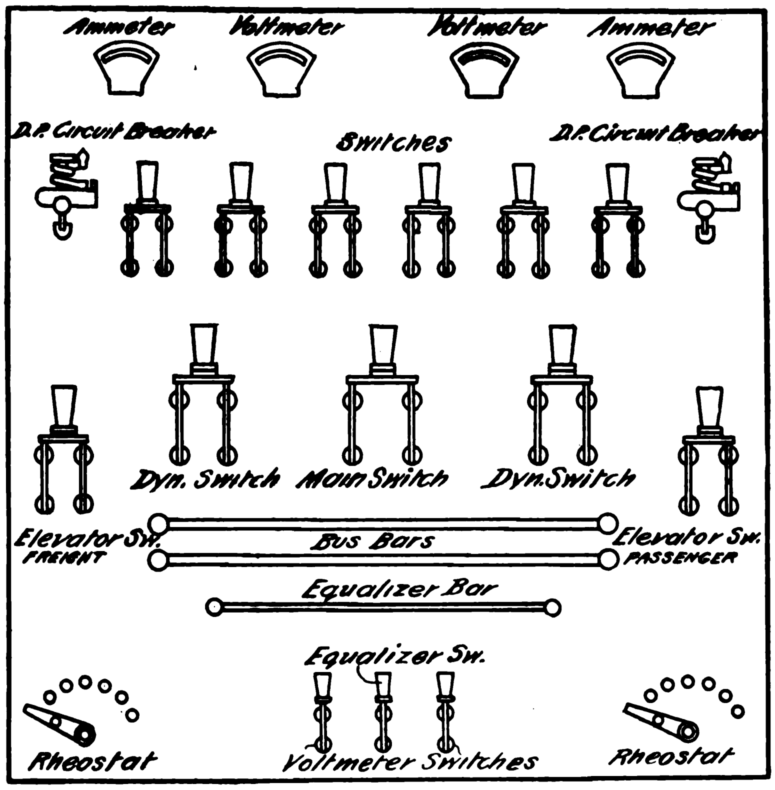
Back View Showing Wiring Connections of Two Compound Wound Dynamos.

A satisfactory method is to lay out the plan of the switchboard so that the marble or slate can be drilled to receive the instruments and switches. These must then be carefully mounted and connected up according to the sketches of the back view. Errors can be readily corrected on the drawing board and the sketches must be carefully examined to detect errors before the board is drilled. In the series of sketches supplied with this article many items shown are more or less arbitrary.

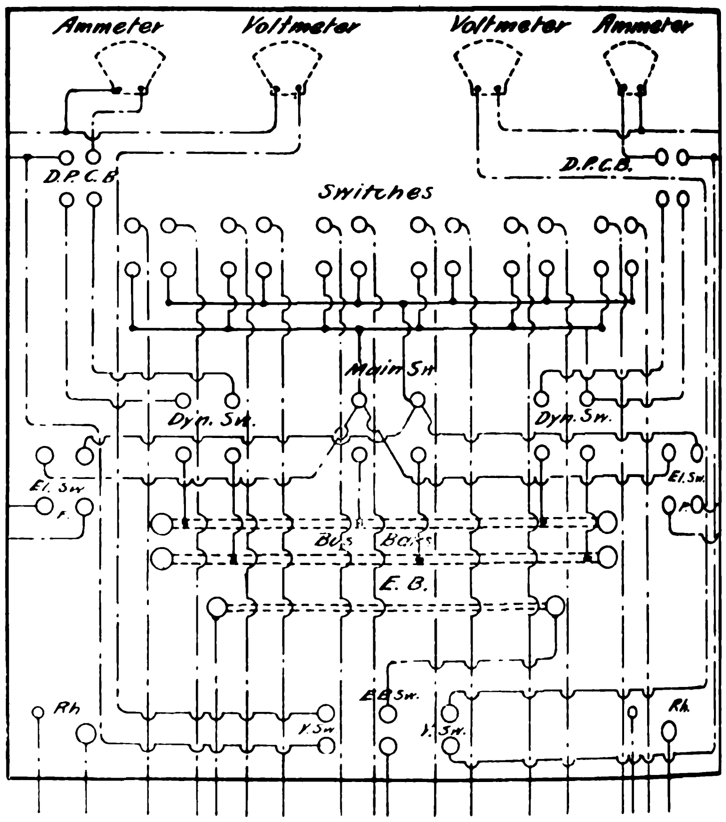
For instance, having the switches in the upper or lower part of the switchboard, using single-pole or double-pole circuit breakers, controlling all main circuits from the switchboards or where they are used, etc. It will be found that the architects' or consulting engineers' specifications will govern all this. If advice is needed, a practical switchboard manufacturer is the best man to consult.

Panel Switchboards.—Not only instruments and switches, but finished panels can be obtained complete from the manufacturer. These panels are in themselves small switchboards although sold under the names of generator panels, rheostat panels, load panels, feeder panels, fuse panels and blank panels. These panels are about 5 feet by 2 feet, although the feeder and fuse panels are about one-half the length of the others.

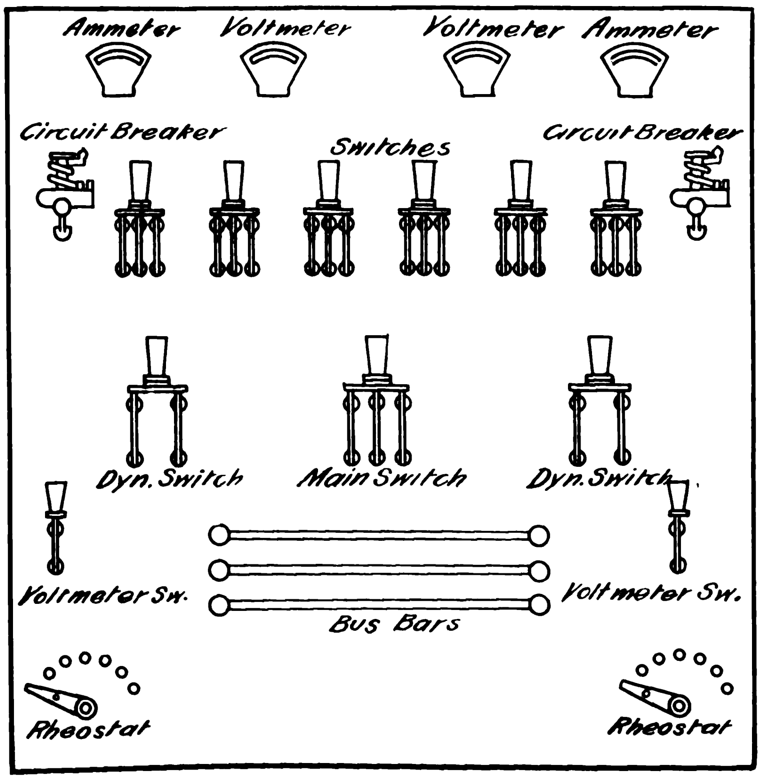
The generator panels are made for either a single generator or designed so that further additions will allow of more than one generator to be run in multiple. The generator panel consists of measuring instruments, ground detector, circuit



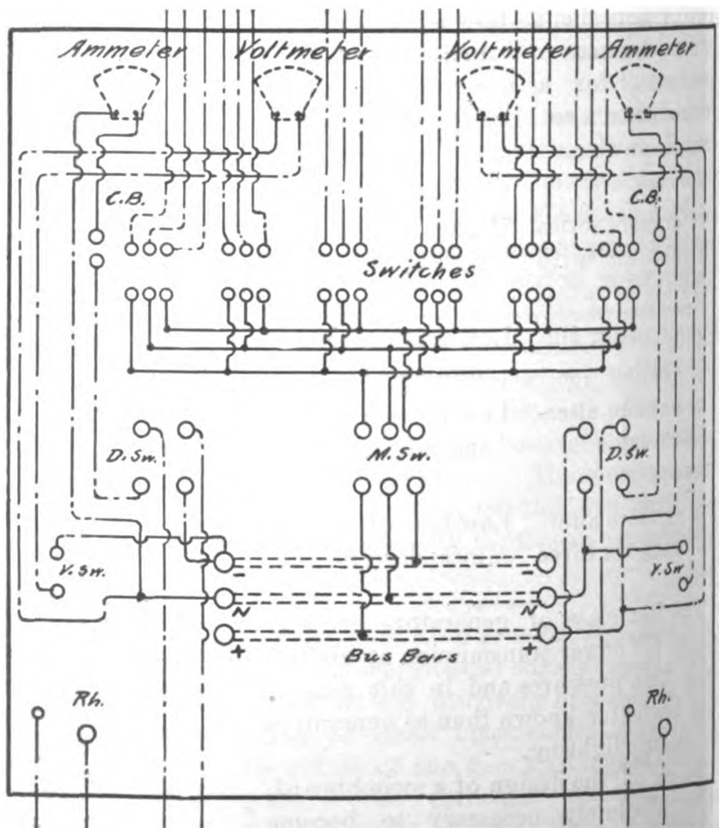
Switchboard of Two Compound Wound Dynamos in Multiple. Switches of 6 Floors and 2 Elevators.



Back View of Switchboard, Showing Connections to Equalizer Bar, Switches and Meters.



Two Shunt Dynamos Connected According to the Three-wire System.



Back View of Connections of Two Shunt Dynamos Operating on the Three-wire System.

breaker, switch and generally a lamp and shade. They are made of a capacity of from 200 to 3,000 amperes. A rheostat panel is used for the purpose of mounting the rheostat on its back, the contacts and arm appearing in the front. The load panel carries voltmeter and ammeter; the voltmeter of the illuminated dial dead beat differential type; the ammeter also with illuminated dial. The voltmeter is mounted on a swinging bracket and is used: first, for measuring the potential of the bus bars; second, for measuring the difference between the potential of the bus bars and that of the dynamo about to be connected. When this last is being accomplished the voltmeter is swung out at right angles to the switchboard and the dynamo tender adjusts the rheostat until the voltmeter reads zero. When the differential voltmeter reads zero the generator switch is thrown in. Load panels are built of a capacity reaching from a few hundred to 15,000 amperes. The feeder panels carry ammeters, circuit breakers and switches. The circuit breakers may be single or double-pole, the ammeters one or many according to the capacity of the panel, which is naturally governed by the carrying capacity of the switches. Only switches may be mounted in special cases on the feeder panels where many circuits must be accommodated in a limited space. The fuse panels are supplied with fuse holders and should carry protected fuses of the most modern non-arcing type. Their capacity ranges from 240 to 1,800 amperes and over, the fuses 60 to 450 amperes apiece. Where blank panels are supplied, either empty sections are to be filled out or a special purpose is held in view.

The so-called direct current lighting and power switchboards, described fully in the bulletin sheets of the leading electrical manufacturers, are generally limited to a pressure of 750 volts. The switchboard is built up by assembling the various panels and connecting together by means of flat bars of aluminum, copper or standard sized wires. The bus bars are supplied specially and provision is made in the panels for their attachment. The cheapness and convenience of this style of sectional switchboard has recommended it strongly to the attention of contractors and prospective proprietors of private plants.

Switchboards for Electrolytic Work.—Generators developing heavy currents for electrolytic work were left out of the list on account of the infrequency with which the design of a switchboard for that purpose arises. In a switchboard installed for this class of work switches were designed to carry 6,000 amperes apiece. In this case the switches can be single poled because of the low pressure. Wherever connections are made the greatest care is necessary to secure a low resistance joint. Heavy copper bars are employed to conduct the current from point to point. The back of the switchboard when finished was provided with triple copper bars, each bar slightly separated from its neighbor to give radiation whenever the current was conducted from point to point. Great copper refining and plating plants are equipped with switchboards of this character.

ACTION OF LIGHTNING STROKES ON BUILDINGS.*

BY KILLINGWORTH HEDGES, M.I.C.E.

In a paper entitled "The Protection of Buildings from Lightning," which was read at the Glasgow meeting of the Association in 1901, the author mentioned the establishment of the Lightning Research Committee, organized jointly by the Royal Institute of British Architects and the Surveyors' Institution, who have since investigated a very large number of occurrences from the reports furnished by their observers. It was decided after the first year to confine the committee's investigations to buildings which were fitted with conductors; and, following this course, the reports on about 40 protected buildings affected by lightning have been summarized by a sub-committee, and are having the attention of the general committee, who will in due course issue a report.

The principal causes of the failure of the usual style of lightning rod as fitted on the buildings investigated appear to be due to the following: (1) Insufficient number of conductor and earth connections; (2) the absence of any system of connecting the metallic portions of the buildings to the lightning conductor, especially the interconnection of the finials, rain-water pipes and gutters. In the author's opinion, the frequent damage by side-flash from the conductors might be lessened by running a horizontal conductor along the ridge, or along the parapets of all the roofs, somewhat after the method which is almost universally adopted in Central Europe.

The lightning strokes may be divided into three classes: (1) Those where the conductor conveyed a portion of the flash to earth, but the side-flash to other unearthed metallic conductors damaged the building; the practice of running the conductor round the projecting masonry, often taking sharp bends, doubtless facilitated the deviation of the current from its direct path to the earth. (2) In several observations a metallic roof of large area received the flash, consequently became highly charged, and the single conductor failed to convey the whole of the stroke—a portion of which took a circuitous path—for instance, through a speaking tube and an electric bell wire. (3) A flash struck the building at two points simultaneously, a lightning conductor taking one part of the stroke, but damage was caused by the other portion selecting an unprotected part of the roof.

Earth Connections.—With a few exceptions, these had the defect common to nearly all earth-plates which are simply buried in the ground close to the foundations of a building, and owing to drainage soon became dry, consequently are of very high resistance. Architects, as a rule, object to sufficiently deep holes being made near a structure; consequently the permanently moist ground is not reached. The tubular earth designed by the author does away with this objection, and can be kept moist by leading a small tube to the nearest rain-water pipe.

Interconnection with the Metal Work of a Building.—Although the utility of the external metal was specially put forward in the report of the Lightning Rod Conference in 1882, their recommendation has been apparently disregarded in all the cases under review. The Cavendish Laboratory stroke, which was fortunately unattended with danger owing to the gas in the gas-pipe which formed the path of the current being turned off, would have not taken this circuitous path had the leaden roof been connected to the conductors which ran down the tower only, also to the rain-water gutters and pipes, which should have been interconnected at the bottom and properly earthed. Again, at Bedford last year, St. Paul's Church was seriously damaged by the flash leaving the single conductor on the tower by the water on the roof and passing thence to earth by means of the rain-water pipes. In this case it is interesting to note that the lead pipes were not fused, but their round section was changed into an oval one; the iron water-pipes were broken. This incident and No. 68 (St. Pancras Church, Euston show clearly that the damage was due not to direct stroke, but by a portion of the flash leaving the main conductor, and taking a circuitous path round the unconnected metal work outside and inside the buildings.

Observation No. 2, Kea Church, Truro.

* Paper read before the British Association at Cambridge, Eng., Aug. 22, 1904.

—The copper sheathing of the spire, owing to its great capacity, could not discharge through the one excellent conductor to earth, consequently the flash divided, part going by the conductor and part by the alternative path formed by the copper covering of the spire to a rain-water pipe, thence sparking through a parapet wall to lead flashing down another pipe, and then along a very small copper wire, used for training plants, to the main conductor. Similar effects were noted in Stoers Lighthouse and Devaar Lighthouse, the divided flash in the former leaving the conductor for a telephone wire and in the latter for a speaking tube. In these observations the conductors may be said to have acted to a certain extent, and if the structures had been entirely unprotected the damage would have been greater, but by proper attention to the necessities of each case, and increasing the number of the conductors, the risk would probably be nil, as there would be a definite path for the lightning to take.

Quite the most interesting case is that at Possingworth House, struck in June and again in August, 1902, although the roof fairly bristled with air terminals, every chimney being protected, mostly with its own conductor and earth connection. It is probable that on the second occasion the flash divided, one part selecting a chimney stack, which is damaged, bending the air terminal to an angle of 45 degrees, while the other, neglecting the many points, fell on an unprotected statue, much lower than the chimney, and went to earth by the iron frame of a conservatory, showing the unreliability of a number of independent conductors which should have been interconnected by means of a horizontal wire led along the ridge; this would in all probability prevent any serious damage.

Sir Oliver Lodge has shown by an interesting experiment that a column of hot air is often selected by a flash, although a lightning rod may be affixed to the side of the chimney. Most of our large stacks have a band of metal to which the air terminals are fitted, and from these two conductors should be led to earth. The method adopted in Germany appears to be simpler, and consists of a heavy iron frame rising to a sufficient height above the stack, and continued at the apex so as to form an aigrette. That lightning may prefer the smoke issuing from a chimney was shown by the stroke at the East London Waterworks, Sunbury, last year, the flash doing some damage to the capping before it arrived at the standpipe inside, which was a perfect earth, in that it was in direct connection with the company's mains.

The general conclusions arrived at by the author are that there is very little advantage in placing isolated rods on an ordinary building without it has a high tower. A church, for instance, with a spire should have at least two conductors from top to earth. Even then, if any other part of the structure happens to be in the path of a discharge from a cloud to the ground, the stroke may disregard the protected towers or spire and fall on the building, choosing some lower point. If the suggestion put forward by Sir Oliver Lodge at the Bath meeting in 1888 was more closely followed, and the conductors so arranged that they form a protective network over all the roofs, a flash would in all probability be received by some portion of the system and pass without harm to the ground by one of the numerous earths to which the network would be connected.

The insurance offices appear to disregard the question of adequate protection, and are quite content if the single conductor which has not prevented serious damage, for instance, to a church is replaced, and, moreover, take no steps to have the earth connection tested periodically; also the few unconnected lightning rods erected on our national museums, picture galleries, and other public buildings contrast most unfavorably with the more scientific methods adopted on the Continent, more especially in Germany, where in some districts the local authorities have issued rules as to the erection and testing of lightning, to which the various public bodies have to conform, and in some cities householders are subject to penalties if the system is allowed to get out of order.

POWER—ECONOMICAL AND OTHERWISE.*

BY CAPTAIN F. S. N. MACRORY, R. E.

"High Pressures"—that is the watchword of success in these modern times. It is applicable not alone to mental activity, but also, and with as much force, to the successful working of all mechanical and industrial problems of the present day. Our fathers walked—we must run. The future generation will probably fly. But let us to our case in point without further preamble—a sign in itself of low pressure.

The example is an Irish oatmeal mill, one of the few survivors of the good old times. For over 40 years the power necessary to drive this mill had been furnished by a low-speed, low-pressure, double cylinder steam engine, of a type well known and justly esteemed in the early sixties. The nominal horse-power (hideous and meaningless term) was 35, and the power actually developed might have been anything up to 60 hp. A good old engine in its way. Built for everlasting wear, old-fashioned, never in its easy-going life exceeding a boiler pressure of 60 lbs. to the square inch, and having even that reduced to 50 lbs. in its latter days, it can easily be imagined that it had a somewhat abnormal appetite for coal. This appetite increased with age. It made light (or more correctly speaking, power) of a daily meal of 25 cwt. of good Scotch steam coal. Without going into details of the milling machinery, we may assume that the full amount of power required to drive it was 45 actual horse power, so that the coal consumption was out of all proportion to the work done. Many expedients were tried with a view to reducing this extravagant consumption, but with little success. Finally, when the question of a new steam boiler began to loom in view, it was determined to relegate the entire power plant to a well-earned rest, and to replace it with something of a more up-to-date type.

Electric transmission from a source of water power three miles distant; new steam engine and boiler; oil engine; gas engine; the choice lay between these four. After due consideration of the pros and cons of each system, the decision fell on the last one. To work a large gas engine with town gas is, however, by no means the height of economy. Nor, in small country towns, is the supply usually all that can be desired, therefore a gas producing plant was also decided on. Of these there are now many varieties on the market. But the latest type, known as the suction plant, seemed to offer so many advantages over the older form, that it was resolved to give it a trial. In this type of plant the gas necessary to drive the engine is sucked in by the latter itself, the out-stroke of the piston producing the requisite vacuum to draw the gas into the cylinder. No gasholder is, therefore, required, and the pressure of gas in the apparatus is below that of the atmosphere when the engine is at work. The small steam boiler required in the case of an ordinary gas-producer is also dispensed with in the suction type of plant, where the generator itself furnishes the steam requisite for the gas production.

The improved Dowson suction plant was accordingly installed as being the

*From the "Electrical Engineer," London.

original, and probably as good as, if not better than, any of the later types. This plant is very simple, and consists essentially of (1) a generator or furnace burning anthracite or coke "nuts"—i. e., cubes about 1 inch square; (2) a water jacket for cooling the gases; (3) "scrubber" filled with coke moistened by a trickle of water, which serves to purify the gases; (4) a second "scrubber" filled with sawdust, which dries and further purifies the gases; (5) an expansion box near the engine, taking the place of the gas bag provided with ordinary gas plants of this nature. The plant is started by blowing a jet of air through the fire in the generator till the gas is rich enough to burn, after which the engine is started, and itself keeps the air draught (now mingled with steam) going automatically. As for the gas engine itself, all the leading makes are probably equally good, though differing in details. In the present case a 50 hp. "National" engine was selected, as the makers of this engine have had great practical experience with the various forms of Dowson plants, and, in addition, turn out a most efficient and highly finished engine.

Next with regard to transmission of power. It must be borne in mind that a gas engine, with its one power impulse in every two complete revolutions, is a very different affair to a steam engine with its two or even more power impulses to every revolution. It was evident that the old system of driving by means of direct spur gearing would have to give way to a belt drive, in order to take up as much as possible the violent shocks of the impulses. And a 10 inch belt, of suitable strength, driving from a 3 foot 6 inch pulley on the gas engine to a pulley of similar size on a countershaft 23 feet distant from the engine, made a most efficient and smooth-running substitute. Fast and loose pulleys were fitted on the countershaft to permit of the engine being started light and the load being applied after the proper speed had been attained, for a gas engine, unlike a steam engine, cannot start under its full load. Another 10 inch belt, in conjunction with a suitable arrangement of pulleys, transmitted the power to the main driving shaft, the arrangement of which remained unaltered. Yet another belt on the countershaft served to drive the remainder of the mill gear, and it may be mentioned now that this system of driving entirely by belts has proved eminently satisfactory. A little dressing on the belts occasionally obviates all tendency to slip—that bugbear of the belt user.

And now to revert once more to the gas engine. It was resolved to have electric ignition, instead of the older type of firing the charges by means of a porcelain tube heated by an independent supply of gas. The electric type consists of a small Simms-Bosch magneto, having permanent magnets and an oscillatory armature. When the engine is working, a sharp rocking movement is imparted to this armature by a small stud on the cam shaft at the right moment for firing the charge, and an electric spark is thus produced inside the combustion chamber. With regard to cooling the cylinder of the engine. In most cases a supply of water tanks are required for this purpose, but in the present case these were dispensed with, as a source of running water was available. The water was simply led by pipes in at the bottom of the water-jacket and out at the top. By regulating the supply the cylinder could be kept at any desired temperature. The "National" self-starting device consists of a small hand pump fixed on one side of the cylinder, by means of which a starting charge of explosive mixture is forced into the cylinder, and the magneto lever being then oscillated by hand, the first explosion takes place, after which the engine takes up the running.

We have now reviewed the whole of the new driving plant. Let us pause to consider the relative space required for both the old and the new systems. In the case of the steam engine, an engine room 29 feet by 11 feet was required, while the boiler occupied a space of 25 feet by 9 feet—in all, a total space of 558½ square feet. In the case of the gas engine, an engine room 18 feet by 13 feet was found ample, while the gas-producer plant required a space of 15 inches by 10 inches—in all, a total space of 384 square feet. Thus the space required for the new plant is only about two-thirds that of the old one. There is an additional saving of space, as no steam stack is now necessary.

We next turn to the relative fuel consumptions of the two systems. The average amount of this for the steam plant under full load, worked out at 25 cwt. per day of Scotch steam coal, costing about 17s. per ton—that is, assuming the full load to be 45 actual horse power, and the working day to be 10 hours in length, the power in this case cost .566d. per horse power hour. Under the same conditions, the fuel consumption of the gas engine never exceeded 5 cwt. per day, the fuel being Welsh anthracite "nuts" or "peas," costing about 24s. per ton delivered. From this, the power works out at .16d. per horse-power hour. This shows a very remarkable saving, and it would therefore appear certain that, as far as actual running goes, nothing but water power has yet been invented which can compete with such a system of power production as the one under consideration. Even the latest and best of steam engines would probably cost twice as much in coal to generate the same power.

With regard to the actual starting up each morning and management during the day of the gas producer and engine, the work required is simple enough when things are going right (that "when" is an important point, as will be shown later on). The daily routine is as follows: The fire in the generator having been left slowly burning all night (which can be done every night except in the case of the periodic cleaning of the generator), the engineer on arrival proceeds to close up the grate doors and to fully open a waste cock on the gas pipe. He then puts in a charge of about eight bucketsful of coal, and starts blowing the hand fan. In about a quarter of an hour the gas produced will be rich enough to burn and, when this is so, the waste cock is closed, and the gas produced is then forced through the cleaning apparatus of the plant to the engine. In a few minutes all the air will have been expelled from the pipes, etc., and the gas will burn at the engine test cock. About 60 strokes of the hand pump are given, and the engine is started in the usual way. Once started and the proper steam attained, the belt can be shifted from the loose to the fast pulley, and no more attention is required, except to see that all lubricators are working properly on the engine, and once in every three hours to add a few more bucketfuls of fuel to the generator. The whole operation of starting occupies less than half an hour, and is only increased by a few minutes on those occasions when the fire in the producer has to be lit and the apparatus started up from "the cold."

Lastly, let us review what is perhaps the most important point of all, simply for the reason that it is only discovered by experience, and is looked in vain for in the makers' catalogues. In other words, let us go into the drawbacks and disadvantages of the whole system. Its advantages are so very apparent that one naturally wonders why it is not universally adopted by all users of power. Well, there is undoubtedly one great drawback to gas engines worked by producer gas, which at present precludes its adoption in a vast number of cases. As now made, at all events, it has not by any means attained to the same pitch of almost absolute reliability, which steam, electric or water power have. There is

no doubt on the subject—it is tricky, deuced tricky. Inexplicable breakdowns may and do occur at the very moments when one least desires or expects them. Of course, skillful and thorough attention to details largely obviates this risk, but it is always there to some extent. And in the case of large factories, etc., which employ a great number of hands, even a temporary breakdown, which will throw all these hands out of work for the time being, is a most serious affair. Lack of absolute reliability—that is the drawback which in so many cases counterbalances the many great advantages of the gas-producing power system. We never get Perfection (with a big P) in this world. Our object is to get as near it as we can. Such little things will upset the equilibrium of a gas engine—things that, once located, can be often put right in less than a minute. But the locating is the trouble.

There was a little girl of whom it was written that "when she was good, she was very, very good, but when she was bad she was horrid." Even so it is with oil and gas driven engines, not to mention their relatives—those most notorious offenders of all, automobiles. Yet all these things have come to stay (or, more correctly to go), for in their better moods they are so fascinating that one is compelled to overlook their occasional lapses from virtue; in fact, one sometimes loves them all the more for these very lapses.

But now the worst is out, and be not discouraged to much by it. Let us see how we may, as much as possible, avoid these occasional breakdowns. With regard to the producer itself, attend rigidly to the makers' instructions. Clean the generator thoroughly, and rake out all clinker at least once a week. Clean all the pipes and water joints of the rest of the apparatus at least once a fortnight. Renew the coke in the coke scrubber not seldomer than once in three months, and perform the same operation for the sawdust scrubber every month. Do not go on the principle of letting well enough alone till a stoppage does occur. Prevention is better than cure.

With respect to the engine, it must be borne in mind that producer gas is, after all, a comparatively new thing, and its effect on the valves and interior economy of gas engines is still, to a certain extent, unknown. The trouble with it is that, in spite of all cleaning operations, it still remains a much dirtier article than town gas, and tends to foul everything that it comes in contact with to a proportionate extent. In the case I am dealing with, it was found necessary to clean the exhaust valve of the engine twice a week—just four times as often as recommended by the makers—otherwise, explosions in the silencer, weak and irregular running, and, perhaps, total stoppages occurred. The operation can, however, be satisfactorily performed in an hour. Once a fortnight seems sufficiently often to clean both the gas and air valves. The electric ignition system requires attention twice a week, in order to prevent the sparking device inside the combustion chamber from sticking. In addition, it is, of course, necessary to keep all insulated parts in good order and terminals clean. But, on the whole, this part of the plant is wonderfully free from trouble, if a little intelligence be exercised in its management. There are also many other little points which each user finds out for himself by actual experience—not too bitter, let us hope.

Depreciation of the plant due to wear and tear has not yet been touched on. A fair estimate would probably be 10 per cent. per annum on the initial outlay—about the same as on a steam plant of similar power. The upkeep of a gas engine is slightly higher than that of a steam engine, but the upkeep of a producer plant will certainly work out considerably lower than that of a steam boiler.

So the sum total of the whole matter seems to be this: Producer gas as a source of power is very highly to be recommended where an occasional stoppage in the course of a day's work is not of vital importance, but in all other cases it has hardly yet attained to a sufficient pitch of reliability to warrant its introduction. It has, at all events, a great future before it.

ON LARGE BULB INCANDESCENT ELECTRIC LAMPS AS SECONDARY STANDARDS OF LIGHT.*

BY J. A. FLEMING, M.A., D.SC., F.R.S.

The importance of possessing a secondary standard of light which shall be at once portable, convenient, and constant is generally acknowledged, and the choice lies between some form of flame standard and some form of incandescent standard. For the last eight years the author has employed as a secondary standard of light a large-bulb carbon-filament electric incandescent lamp, which was first devised by him in 1895 in connection with photometric work carried on in the Pender Electrical Laboratory at University College. These lamps were made by the Edison & Swan Electric Light Company, and a large number of them have been issued to the public under the name of the Fleming-Ediswan photometric lamp, together with a certificate of the author as to the photometric value. The principle underlying the construction of these lamps is as follows: It is well known that some types of carbon filament glow lamp, when worked at constant voltage, slightly increase in candle power for the first 50 hours or so of their life. After that life a stationary period is reached, and then a progressive drop in candle power takes place. The initial rise in candle power is due to a gradual consolidation in the filament with use, which reduces its resistance, and the subsequent decay in candle power is chiefly due to the deposit of carbon upon the bulb. The surface of an ordinary incandescent lamp, 16 cp., is approximately equal to that of a sphere 3 cm. in radius, and may be taken, roughly, at 120 sq. cm. Accordingly, an ordinary small bulb incandescent lamp is not very suitable as a standard lamp. The writer found, however, that by inclosing the filament in a bulb of much greater diameter, say in a cylindrical bulb 12 cm. in diameter and 20 cm. in length, giving a total bulb surface of nearly 800 to 1,000 sq. cm., the deposit of carbon upon the bulb was greatly diminished: first, because the glass is further removed from the filament, and, therefore, the chances of a carbon molecule getting on to the glass are reduced; and, secondly, because the carbon that is deposited is spread over such a much large area of glass that its effect in interfering with the passage of light is greatly diminished. Again, it was found that by subjecting the carbon filament to a certain process of aging in another bulb before transferring it to the large bulb, the rise in the resistance of the filament was, so to speak, anticipated. Accordingly, lamps were made to the following specification: Well-selected carbon filaments of the single-loop type of 10 cp. or 16 cp. were aged and adjusted to an efficiency of 3.5 watts a candle. These filaments were then transferred to large cylindrical bulbs of very clear glass and finished in the usual manner (see Fig. 1).

Such a large bulb lamp may be called a photometric lamp. A mark is placed on the glass or on the collar of the lamp in such a position that when the lamp is mounted in the photometer with this mark facing the photometer disk, the axis of the lamp being vertical, the plane containing the horseshoe filament is perpendicular to the line joining the lamp

*Paper read before the British Association at Cambridge, Eng., August 22, 1904.

with the photometer disk. These lamps are intended to be used in the following manner by a process of photometric "double weighing." Each standard lamp is marked with the voltage at which it will give a certain candle-power in the above-mentioned direction and position. A lamp is then used, as follows: Assuming it to be marked, say, 16 cp. at 98 volts, the lamp is placed in the photometric gallery at a distance from the photometer disk of 4 feet—viz., the square root of 16—and by means of a potentiometer and variable resistance, the electric pressure on the terminals of the lamp is adjusted to be 98 volts. Under these circumstances the illumination on the photometer disk is one candle-foot. This is balanced by placing on the other side of the photometer disk any other incandes-

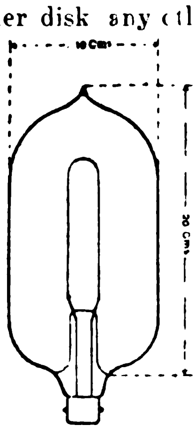


Fig. 1.
The Fleming-Ediswan Photometric Incandescent Lamp.

cent lamp worked at about the same watts per candle, the distance of this last lamp (called the comparison lamp) being adjusted until a photometric balance is obtained. The standard lamp is then removed from the photometer, and its place is taken by any other lamp the candle-power of which it is desired to ascertain at a certain voltage. The voltage having been adjusted, this last lamp is then moved to or from the photometer disk until it photometrically balances the comparison lamp. Let us imagine that it balances the comparison lamp at a distance of 50 inches. The candle power of this last lamp is than equal to 17.36 candles, being to the standard lamp in the ratio of the square of 56 to the square of 48. Such an operation has been called by the author a photometric double weighing, because it resembles the process by which the exact weight of an object can be ascertained by means of good weights with an imperfect balance. By following the above method no want of symmetry in the photometer vitiates the process of measurement, neither are we concerned with the exact value of the comparison lamp as long as it remains constant during the experiment. All that we are concerned with is the exact value of the standard lamp used for setting the comparison lamp, and with the ratio of the distance of the standard lamp from the photometer disk to that of the measured lamp. Hence, if the distances are correctly measured, we have the exact ratio between the candle-power of the standard lamp and that of the lamp being measured.

It has been found by large experience that this process is more accurate than the usual plan of placing the photometer between the two lamps and moving the photometer to and fro until the balance is obtained. In this last method we are liable to error in consequence of any want of symmetry in the photometer itself, and also by reason of the fact that the continual moving of the photometer varies the value of the absolute illumination of the photometer disk. It has been found that even when using the best Lummer-Brodhum photometers there is a certain symmetry in the instrument of the disk. If a photometric balance is obtained between the two lamps, one on each side of the photometer, then on reversing the disk the balance is no longer obtained, but the photometer has to be moved to a further position. This difference is not apparent when the photometer is simply turned, prisms and disks moving together, but differences mounting to 5 per cent. in the value of the readings of the candle-power of a lamp have been found in some instances when the disk alone is reversed.

These large bulb lamps are not intended to be used as working standards and kept incandescent for any length of time, but merely as secondary standards for a few minutes to adjust the distance of the comparison lamp and from the photometer disk. In this manner it may be used many thousands of times without being in a state of illumination altogether for more than a few hours. By having a large number of these lamps in constant use and checking them one against the other, and never allowing the voltage on the lamp to exceed the marked volts, a means is provided of determining and preserving a standard of light with very considerable accuracy.

In connection with the construction of these large bulb lamps, the following points are important. The filament should preferably be in the form of a single loop or horseshoe, and should be mounted in the large cylindrical bulb with great care so that the plane of the loop lies in the axial line of the lamp, filaments being selected with the two sides of the loop in the same plane and not distorted. In some cases it is desirable to anchor the filament by a loose loop of platinum wire, sealed into the bulb, but such loop of wire should not touch the filament or constrain it when the lamp is at rest or in use. Owing to the fact that the 16 cp., 100 volt filament is about 9 inches in length, it is desirable, if possible, to employ a 10 cp., 60 volt, large bulb photometric lamp as a standard. The 16 cp., 100 volt lamp of this type is much used, and the 16 cp., 200 volt lamp has been made, but is not recommended. It is not desirable to employ two filaments in parallel, as they may then be at different temperatures, but they can be placed in series, one loop within the other, and both lying in the same plane. In setting the lamp in the photometer, great care must be exercised to adjust the lamp axis perfectly vertical, and a plumb line should be employed to mark the position of the mean line of the filament as read on the scale of the photometer bench.

In the use of these lamps the following precautions should be taken: (1) the lamp should never be raised above the voltage marked upon it by the manufacturer; (2) in the next place, great care should be taken that good contact is made between the socket and the sole-plate on the lamp. It is better, therefore, to solder a pair of wires to each sole-plate of the lamp-collar, one pair being employed as the leads for the current to the lamp, and the other pair as potentiometer or voltmeter wires to ascertain the exact potential difference between the sole-plates of the lamp. This adjustment of potential is best effected by means of a variable rheostat and a potentiometer. In the certificate issued with each of the Fleming-Ediswan photometric lamps a statement is made of the exact voltage and current at which the lamp gives a certain candle-power at a certain temperature. If used with the above precautions, experience accumulated during the past eight years has shown that these lamps are capable of preserving an exceedingly constant candle-power, and that as standards of light they are more portable and require none of the corrections necessary in the case of flame standards.

The great objection which may be urged against the use of all flame standards is the degree to which their candle-power is affected by moisture in the air and changes in barometric pressure. It has been shown by researches made at the Reichsanstalt on the Hefner lamp that the light emitted decreases about 0.5 per cent. with every additional litre of water vapor present in the atmospere

above a certain normal value. Taking the average variations of moisture in the air from month to month, we find that this implies a variation of about 4 per cent. in the light emitted in the Hefner lamp between the wet and dry seasons of the year; this variation greatly exceeds the limits of possible error in photometric observations. With very little care photometric comparison can be made within 1 per cent., hence comparisons with a flame standard are not sufficiently definite unless the value of the flame standard has been corrected for moisture and barometric pressure. The authorities of the Berlin Reichsanstalt take the standard state of the atmosphere with regard to moisture to be that in which it contains 8.8 litres of water vapor per cubic meter of dry air. The atmosphere of Berlin, however, is distinctly drier than that of London, and the author has been informed by Dr. Glazebrook, F.R.S, director of the National Physical Laboratory of England, that he considers for Great Britain it will be better to take as a standard state 10 liters of water vapor per cubic meter of dry air as more nearly representing the average state of the British atmosphere.

(*To be continued.*)

To Establish Turbine-Equipped Works.

A large scheme for the electrical transmission of power is proposed to be carried out by the Ruhr Valley Damming Company, near Gemund, in the vicinity of Aix-la-Chapelle. It is intended to establish turbine-equipped works for the utilization of the available water power and the production of electrical energy for transmission, at a pressure of 34,000 volts, for the supply of Aix-la-Chapelle and a number of neighboring towns and localities.

The order for the generators, which will be of the 5,000-volt class, has already been given to the Lahmeyer Company, while the Siemens-Schuckert Works Company has received the contracts for the generating station transformers and switchboards, and also for 16 out of the 17 substations' transformer plant. It is proposed to transform the primary generating current at 5,000 volts to 34,000 volts, and to transmit it by means of bare overhead copper conductors to the substations, where it will be converted into low pressure current and distributed by means of underground cables.

The scheme, which represents the largest power transmission project in Germany, is expected to form a model for other installations of a similar character in the near future.—*London Financier.*

The Slackness of Electrical Trade in England.

(From our London Correspondent.)

Every week brings additional evidence to prove the present very unsatisfactory condition of British electrical manufacturing. A few years ago, when municipal lighting and tramway development was at its best, British manufacturers were being urged on every hand to make wide extensions of their works so as to be better able to meet the needs of the country with greater expedition and with more economical production costs, rendering it easier for the Britisher to compete with the Continental dumper, who was depositing surplus manufactures at less than cost price.

The extensions were made—in some cases with reluctance—and to-day there are undoubtedly quite sufficient modernized electrical manufactories established in the United Kingdom to cope with a fairly large demand for machinery and apparatus required in every department of electrical work. But, unfortunately, owing among a number of causes to the course which municipalization agitations have taken and the difficulty experienced in getting money from the investing public, there is a serious lack of orders.

It follows as a natural corollary of this condition of trade that these extended and other electrical manufactories find it a matter of the utmost difficulty to obtain sufficient contracts to enable them to keep their works in operation and to make a profit on their turnover. Some of them had to go so far as to drop all hopes of earning profits for a time if they can only manage to get the work to do so that the men may kept employed.

Water Power Plant in Japan.

The hydro-electric power installation in Iyo makes use of the various rapids in the River Ishite, of which Wakigafuchi is the highest. The quantity of water varies from 40 cubic feet per second at low water to 100 cubic feet at high water, the mean flow being about 50 cubic feet per second. The 260 kw. of power developed are obtained from an actual head of about 100 feet, with a steady flow of about 50 cubic feet per second. Across the stream is placed a straight stone weir 132 feet long, which dams up the water to a height of 4 feet from the canal bottom. The water enters the canal about 3,000 feet from the reservoir, which is located near the plant. Along the cliff, at a distance of about 300 feet from the entrance, is placed on wooden sleepers a semi-circular steel flume 45 feet in diameter, which connects with the canal. The canal is 4 feet wide at the bottom and 5 feet in height.

The reservoir is 10 feet wide, 15 feet long and 5 feet high. It contains an iron rack, which rests on the bottom, and is inclined at an angle of about 60 degrees, in order to arrest all floating material, such as logs, leaves, etc. A steel pipe line, 230 feet long, connecting with the reservoir, runs to the foot of the mountain, where the power station is located. The pipe is 3 feet in diameter throughout its whole length, and is built of steel plates 3-16 inch to 3/8 inch in thickness. At the end of the pipe there are provided a safety valve and a manhole to permit of periodical cleaning and draining. At present there are in the power house one water wheel, an electric generator and a switchboard. The water wheel develops 380 hp. at 600 revolutions per minute, a suction pipe 15 feet long being used.

Regulation of speed is accomplished by Voith's governor to within 3 per cent. The turbine is connected directly through a leather coupling to a three-phase generator of the revolving field type, developing 260 kilowatts at 3,500 volts, the frequency being 60 periods per second when running at 600 revolutions per minute. The exciter is wound for 110 volts, and is placed on the same shaft with the generator. The three-phase transmission line consists of No. 3 B.W.G. wires, fixed to petticoat insulators. Telephone wires are also strung on the poles. Both the primary and secondary wires enter the transformer chamber by way of a vertical pipe 20 feet above the roof of tower. In the chamber are two 10-kilowatt transformers.
—*Practical Engineer.*

Power Deal Closed.

A dispatch from Buffalo, N. Y., received on Monday, says: "It is rumored here that the New York Central has closed a contract with the Ontario Power Company of Niagara Falls, Ont., by which the Central will secure the entire production of electricity for the first 25 years. The Ontario Power Company is in process of construction and it is expected that it will be finished next year when 8,000 hp. will be developed. After that the power will be increased to 25,000. General Francis V. Greene is general manager of the company. At his office it was impossible to get a verification of the rumor, but from authentic sources it was stated that the contract had been made and signed."

Control of the National Carbon Company.

President James Parmelee of the National Carbon Company has denied in a number of private dispatches the report that the company is to be swallowed up by the General Electric Company. Notwithstanding, however, it is known positively that a certain coterie of men who manage the General Electric Company practically have control of the Carbon Company and also that this fact will be proven true by changes in the management of the latter concern which are expected to take place at the annual meeting of the company. A large amount of the stock has been sold on private terms to General Electric interests during the last six months, one interest in Chicago alone being credited with having purchased several thousand shares of both classes of stock for these parties.

Tesla Patents Upheld.

The U. S. Circuit Court of Appeals at Boston has reversed the decision of the lower court and decided in favor of the Westinghouse Electric Manufacturing Company against the Stanley Instrument Company, upholding the Tesla patents, relating to the conversion of alternating currents of electricity into a continuous current.

To Test Clergyman's Wireless Telegraph System.

The American Electric Signal Company of Philadelphia has secured the contract for the erection of Father Murgas' wireless telegraph system between Wilkes-Barre and Scranton. Towers 200 feet high will be built and the receeiving stations will be small one-story houses, 18 by 23 feet, which will be erected between the twin cities. Towers at Wilkes-Barre and Scranton will be equipped with receiving and sending apparatus.

The inventor is confident that with towers 200 feet high he can communicate from Wilkes-Barre to Philadelphia, which is 150 miles distant. If the test between Wilkes-Barre and Scranton is a success, a station will at once be erected in Philadelphia.

Foreign Visitors Surprised.

The electric marvels of this city gave the International Congress delegates a surprise, and before leaving for St. Louis many of the distinguished electrical engineers, who were shown the subway, said that no plant in the world, not even the great one of the Corporation of Glasgow Railway, compares with this in size, ease of operation, perfection of safeguards and susceptibility of manœuvring. The visitors were struck with the little human power needed to man the station. Only 300 men will be employed there, and only three men will operate the greatest switchboard in the world. They will handle little switches which control only 110 volt currents, but these in turn control 11,000 volts. Thus the men do not have to handle high tension currents at all, and a large factor of danger is eliminated.

Four big engines were running for the benefit of the visitors. Each of these engines is 45 feet high—as tall as most of the residences on Manhattan Island—with whirring wheels 45 feet in diameter between them. They marveled at the 60 big boilers, half of which are automatically stoked. They learned that 900 tons of coal will be consumed a day to keep this plant going when the entire subway is in operation.

Paint for Mills.

Mill owners fully appreciate the desirability of having their buildings present a well-kept appearance, but their chief difficulty has been to secure a paint that would not blister and crack in a season or two.

To preserve and beautify structural iron, metal surfaces and smoke-stacks, a paint must be used which will not be destroyed by continued exposure to the rust-forming elements, heat of the sun and rain.

The expense and annoyance of frequent repainting can be avoided by the use of a coating of flake graphite and silica for pigments, and boiled linseed oil for a binder, and a product of this nature is made under the trade name of Dixon's Silica-Graphite Paint.

This product has certain economical features over the ordinary paints, in that the flake graphite is a lubricant, and in its use as a pigment the paint is brushed on with great ease, saving materially in cost of labor and brushes, and gives a covering power of 500 to 600 square feet to the gallon for a good coating. Dixon's Colors have given a service of seven years on the iron-covered elevator building of the Kentucky Public Elevator Company, Louisville, Ky., 11 years' protection without repainting on the one mile, four track wide steel elevated structure of the Pennsylvania Railroad Company, Jersey City, N. J., and five years on the 150 feet steel smoke-stack of the Columbus-Edison Electric Light Company, Columbus, Ohio.

A practical little folder entitled "Colors and Specifications," illustrated with five different types of steel construction, and containing suggestions for construction and maintenance painting, with the four colors of Dixon's Silica-Graphite Paint, can be secured by addressing the Joseph Dixon Crucible Company, Jersey City, N. J.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPT 6, 1904.

Electric Railways and Appliances.

769,214. Block Switch and Signal System for Electric Railroads. Thomas F. Gaynor, Brooklyn, N. Y., assignor to the Gaynor Train Control Company. Filed Aug. 19, 1902.

769,279. Apparatus for Signaling to Trains. Joseph Seel, Manchester, Eng. Filed March 19, 1904.

769,462. Self-Adjusting Trolley for Electric Railways. Charles C. Benson, Newburyport, Mass. Filed Nov. 19, 1902.

769,540. Audible Indicator for Electric-Light or Electric-Motor Circuits. Joseph P. Gillette, New London, Conn. Filed Dec. 22, 1903.

769,685. Electric Railway-Switch. Schuyler C. Gurley, Indianapolis, Ind. Filed Sept. 8, 1903.

Electric Lights and Appliances.

769,236. Electrode-Holder for Electric Headlights. Mark A. Ross, Chicago, Ill., assignor to the Pyle National Electric Headlight Company, same place. Filed Oct. 15, 1903.

769,273. Inclosed Electric-Arc Lamp. Henry C. F. M. Petitdidier and Theodore M. Schmitt, Paris, France, assignors to themselves and Victor Reclus, same place. Filed Nov. 10, 1903.

769,303. Means for Supporting Electrical Lamps. William B. Churcher, Cincinnati, O., assignor of one-half to Albert F. Maish, same place. Filed Dec. 26 1899.

769,486. Electric Signal-Light for Railway-Switches. Judson McFell, Chicago, Ill. Filed Sept. 28, 1903.

Electrical Machinery and Apparatus.

769,195. Brush Holder for Electric Generators. Leon R. Smith, Pendleton, Ind., assignor to the Motsinger Device Manufacturing Company, same place. Filed April 13, 1904

769,342. Method of Regulating Alternating-Current Generators and Circuits. Ludwig Gutmann, Peoria, Ill. Filed June 29, 1901.

769,406. Means for Controlling and Regulating Electric Motors. Gustaf Rennerfelt, New York City. Filed Nov. 9, 1903.

769,572. Time-Limit Device for Electric Switches. Samuel B. Stewart, Jr., Schenectady, N.Y., assignor to the General Electric Company. Filed May 31, 1902.

769,619. Starting-Rheostat. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company. Filed July 26, 1901.

769,638. Regulation of Electric Circuits. Howard R. Sargent, Schenectady, N.Y., assignor to the General Electric Company. Filed Nov. 28, 1900.

769,639. Cleat for Electric Conductors. Howard R. Sargent, Schenectady, N. Y., assignor to the General Electric Companyy. Filed March 26, 1902.

769,652. High-Potential-Energy Detector. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to the General Electric Company. Filed March 13, 1903.

Telephones and Telephone Apparatus.

769,306. Telephone or Telegraph System. Frederick E. Denzer and William W. Black, Everett, Wis. Filed Sept. 3, 1902.

769,658. Telephone-Receiver. Ray H. Manson, Chicago Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Aug. 3, 1903.

Miscellaneous.

769,203. Electric Signal. William T. Wheeler, St. Louis, Mo. Filed Nov. 7, 1903.

769,250. Electric Furnace. Michael R. Conley, New York City, assignor to the Electric Furnace Company, same place. Filed Oct. 1, 1902. Renewed Jan. 27, 1904.

769,403. Secondary or Storage Battery. Carroll Potter. Philadelphia, Pa. Filed Dec. 21, 1903.

769,409. Electric Signaling System. Paul H. Schmitt Chicago, Ill. Filed Nov. 30, 1903.

769,473. Electrical Signal-Transmitter. Arthur C. Ferguson, Brooklyn, N. Y. Filed Jan. 30, 1904.

769,565. Compressed-Air Supply for Electric Vehicles. Roland Le Baron Owen and Robert O. Le Baron, Pontiac, Mich. Filed Sept. 30, 1903.

769,599. Brush-Holder. William L. R. Emmet, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 22, 1900.

769,613. Governing Mechanism for Turbines. Oscar Junggren, Schenectady, N. Y., assignor to the General Electric Company. Filed July 22, 1903.

THE TELEPHONE WORLD.

Independents to Meet in St. Louis.

The convention of the Independent Telephone Association of the United States will be held in St. Louis, September 20, 21 and 22. The headquarters of the association will be at the Inside Inn, the only hotel within the Exposition grounds. Special rates for parties attending the convention at the Inn have been secured. The sessions will be held during the mornings, thus allowing delegates and visitors ample time during the rest of the day to look over the Exposition.

Will Not Sell to Bell Company.

Edward R. Conklin, of Aurora, Ill., secretary and general manager of the Interstate Telephone Company, denies the stories that have been circulated that his company is about to sell out to the Bell Telephone Company. He declares that Peoria is one of the centers of the new system, and that within 10 days work will be begun on the new structure on Jefferson street, where the offices of the company will be located.

A new telephone company has been organized at Fort Edward, N. Y., to operate extensively in the North Creek. It will be connected with Indian Lake and Blue Mountain Lake from the north, Minerva, Olmsteadville and other places on the northeast, Tyerna, Holtersville and Luzerne on the south, while the lines will be extended as far westward as Lake Pleasant in Hamilton County, connecting with numerous hamlets in the town of Johnsburgh and in the upper Sacandaga Valley. The charter for this company has been granted.

Since the Marshall, Mich., Telephone Company has been in existence, the Bell exchange has done but one-tenth of the business it previously did, and practically nothing but long-distance work at that. The Bell superintendent at Detroit sent R. L. Trewin to Marshall to solicit, and he expects to get 200 new subscribers in three months. Rates will be cut and other instruments offered. The rates of the local company at present are $9 annually for residences, and $18 for business houses. It is expected a merry war will be waged.

Articles of incorporation of the Interstate Telegraph & Telephone Company have been filed for record with County Auditor Wheeler at Colfax, Wash. J. J. Stephens, of Thornton, is president, and Dr. T. A. Swain, of Pine City, secretary and general manager. Pine City is to be headquarters for the business of the company. The capitalization is fixed at $5,000.

The Schooler Brothers' Telephone Company will begin the construction of a new telephone system in South McAlester, I. T., in the near future. The system will cost $50,000, and be built on the conduit underground system.

The regular quarterly dividend of 1¾ per cent. has been declared by the directors of the Cumberland Telephone & Telegraph Company, payable October 1 to stock of record September 20. Books close September 19 and reopen October 3.

A new telephone company has been organized at Reinbeck, Ia.

Successful Test of Trolley Car Telephone.

On the Charleroi branch of the Pittsburg, Pa., Railways Company there was recently made a final test of the portable telephone for street car use. The test was found satisfactory as far distant as the inventors could get from Pittsburg by trolley, which was 30 miles.

The overhead trolley wire is used for the purpose of transmitting. Each car is supplied with a portable 'phone, hung in a neat box like a suit case, and can be used from any pole along the entire line. From each pole hangs within six feet of the ground a "jack," into which the conductor or operator inserts his plug, and by pressing a button the telephone bell rings in the main office of the company in Pittsburg.

From Pittsburg, connection can be made with the main central. The conductor or passenger in a forest or a field has communication with the entire telephone world. The invention is the work of Superintendent James W. Boden, of the Pittsburg Railways Company.

Detroit capitalists have organized a telephone company with an authorized capital of $100,000, and have obtained a charter to do business in the province of Ontario, Canada. They are empowered to carry on the general business of a telephone company, with various restrictions as to the erection of poles and wires, which guard the rights of private and municipal property. The incorporators are the following: C. W. Taylor, R. Brooks, J. A. McRae, P. T. Chestey, A. D. Prosser, all of Detroit. The company proposes to begin its Ontario operations in the County of Essex.

Articles of incorporation were recently filed with the Secretary of State of South Dakota, for the Dakota Central Telephone Company, with headquarters at Aberdeen, and a capital of $5,000,000. The directors are J. L. W. Zietlow, J. W. Zietlow, W. C. Bicklehaupt, Isaac Lincoln and C. N. Herried. Its purpose is to consolidate a number of northwestern lines in that and adjoining States in one large central company.

James S. Clarkson, Collector of the Port of New York, and former Senator Charles A. Towne, of New York, are two of the incorporators of the Rogers Telephone Company of West Union, Ia., a company just organized with a capital of $50,000.

The Standard Telephone Company of Doylestown, Pa., has opened a direct wire to Philadelphia and is now in a position to give excellent service to Philadelphia and Keystone connections.

The directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent., payable October 1. Books close September 28, and reopen October 1.

Connections have now been established with Indianapolis and Richmond, Ind., by the Home Telephone Company of Dayton, O., over its long-distance wires.

The Tri-State Telephone Company, Winona, Minn., has declared its fifth quarterly dividend of 1½ per cent.

Big Steamship Minnesota's Telephones.

A modern and unique feature of the Great Northern Steamship Company's new vessel, the Minnesota, is the complete telephone system. It is the largest ever placed aboard a ship. As a matter of fact there are two distinct installations, one a general exchange permitting of communication between the various parts of the ship, and the other connecting the various executive offices. Both systems were furnished by the Electric Gas Lighting Company of Boston.

Besides the instruments in the state-rooms, telephones are installed in almost every part of the vessel, such as the captain's private state-room, the ladies' drawing-room, the smoking-room, library, kitchen, pantry, steward's department, laundry, chief engineer's office, and chief electrician's office, so that no matter what a passenger's wants may be, he can be connected with the department desired. The instruments are set flush with the walls, and are finished in black.

The intercommunicating system is distinct from the general system and consists of eleven stations, as follows: The forward navigating bridge, main navigating bridge, after navigating bridge, port and starboard engine rooms, crow's nest, pilot house, chief engineer's office, chief electrician's room, central electric lighting station, and dynamo shelf. Of these the first five are water-tight marine type instruments. This construction is necessary on account of their exposed position to moisture and dampness.

Arrangements have been completed whereby the Wisconsin Telephone Company connects with the Monroe, Wis., Telephone Company, giving the Monroe subscribers connection with the Wisconsin Telephone Company's long-distance lines.

Independent telephone men are agitating the question of a Milwaukee connection, and it is said that the managers of the Independent telephone companies of the State will hold a meeting in La Crosse or Madison in the near future to discuss the question.

At a meeting of the executive committee of the Interstate Independent Telephone Association of the United States, it was decided to hold the annual convention at Chicago on December 13, 14 and 15.

The International Telephone Company of Fort Frances, Ont., composed of local men, has been formed and is at work putting in an Independent telephone service for the town.

The Lee County Telephone Company of Dixon, Ill., will spend about $75,000 in rebuilding its system. The new plant will include a new subway system.

Telephone Incorporations.

The Manning Telephone Company, Manning, Ia. Capital stock, $21,000.

The Jefferson Telephone Company, Jefferson, N. H. Capital stock, $1,000.

The Canastota Telephone Company, Canastota, N. Y. Capital stock, $25,000. Incorporators: Charles J. Wood, T. Harvey Ferris, Utica, and Ervin Sattsman, Canastota.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aberdeen, Md.—The town commissioners have purchased the site upon which to erect a new power house for the electric light plant.

Burlington, Ia.—The citizens are agitating the question of electric lights.

Capac, Mich.—At an election held here last week it was voted to issue $7,000 in bonds for the purpose of completing the electric light plant and waterworks system.

Carrollton, Ga.—The citizens have voted to issue $45,000 in bonds for building an electric light plant, waterworks, etc.

Cedarville, Cal.—The flouring mill at Fort Bidwell is to be improved and machinery is to be installed, so that the mill can be operated with electricity which will also light the town.

Clarks, Neb.—The electric lighting plant here was destroyed by fire.

Clifton Springs, N. Y.—This city has advertised the sale of $18,000 worth of bonds to build an electric light plant.

Danville, Ky.—After one of the stormiest sessions ever held here the city council voted to substitute electric lights for gas throughout the city.

Echo, Ore.—This town is to have an electric lighting plant within a short time. The Echo Water, Light & Power Company has been incorporated with $10,000 capital stock and will soon begin the construction of the plant.

Florence, S. C.—Messrs. Measy, Ingram & Case, who have been prospecting here for some time, have decided to put their money and energy in a business here. They will erect a $50,000 electric light and power plant. They have closed a deal for the local plant, and will have full control of the electric light and power business

Indianapolis. Ind.—Within a year this city will be lighted with electricity brought a distance of 160 miles from the immense dams of the Indiana & Michigan Electric Company at South Bend. At a recent meeting of the officials of the company it was decided to extend the transmission lines of the electric company to this city.

Kalama, Wash.—A new electric light plant is to be installed in the residence of J. F. Dufur.

Lincoln, Neb.—Lincoln has voted bonds and sold the same for the establishing of a new municipal electric lighting plant.

Oakland, Neb.—This town will issue $7,000 worth of bonds for the installation of an electric light plant.

Omaha, Neb.—The citizens are agitating the building of a municipal electric lighting system.

Paducah, Ky.—The city is now considering means by which the electric light plant will be considerably enlarged, so as to give better light service.

Penn Yan, N.Y.—A municipal electric plant is to be established here and $30,000 bonds will be issued for that purpose.

Pleasant Prairie, Wis.—This place is to have electric lights for street and residence lighting

Preston, Canada.—The electors of this city have voted in favor of municipal ownership of the electric lighting plant. A new power station will be erected and a first-class plant installed.

Purvis, Miss.—The Purvis Light & Power Company has been organized with W. H. Magee, president, and J. W. Woodward, vice-president. The company will operate an electric light plant, telephone system, waterworks, ice plant, etc.

Richmond, Ind.—This city has begun to light its streets from the municipal electric light plant, the contract with the private company expiring September 1.

Sante Fe, N. M.—The Roswell Electric Light Company has been incorporated with a capital of $50,000.

Thamesville, Canada.—This city has decided to install a waterworks system for fire protection and to purchase an electric light plant and run it as a municipal concern.

Thomson, Ga.—This city will soon erect an electric light plant.

Urbana, O.—There is talk is rebuilding the electric light plant here.

Waverly, Ia.—This town will probably vote on installing a municipal electric light plant.

STREET RAILWAYS.

Chanute, Kan.—Mr. Crouch is trying to secure a franchise for an electric road.

Council Grove, Kan.—Chief Engineer A. L. Hartridge, with a corps of surveyors, has reached this city, having completed the preliminary survey of the Kansas City, Burlingame & Council Grove Railway. This proposed electric railway passes through a rich country agriculturally and through excellent coal fields.

Dubuque, Ia.—The Dyersville & Northern Railway Company, capitalized at $75,000, of which G. H. Nesselman is president, will build a new electric line between here, Dyersviile and New Vienna.

Hannibal, Mo.—It is announced that engineers will commence the work of surveying next week for the proposed electric interurban road from Quincy to this city.

Holly, Mich.—This town will secure a new electric road.

Lima, O.—The Appleyard Syndicate will build a new line through this city.

Mankato, Minn.—The Mankato Railway. Light & Power Company has been granted a franchise for an electric car line.

Mexico City, Mex.—The Mexican Railway, known as the "Queen's Own," the oldest railroad of the Republic, proposes to adopt electricity along its entire line.

Muskogee, I. T.—The second electric railway to be put in operation in Indian Territory is to be built in this city by the Muskogee Traction Company.

Patchogue, N. Y.—The South Shore Traction Company, capital $2,000,000, with $150,000 paid in, has applied to the Railroad Commission for privilege to build, mostly through private property, from Jamaica through Rockville Center, Oyster Bay, Babylon, Amityville, Islip and Patchogue, to Brookhaven.

San Jose, Cal.—An enthusiastic meeting of business men at the Chamber of Commerce last week decided to push the project of an electric railroad up Mount Hamilton to the Lick Observatory. A large sum of money was raised at the meeting to begin the work of surveys and looking into rights rights of way for the road.

Saranac, Mich.—The Grand Rapids & Ionio Electric Railway Company will build a new road here. Frank Westcott, secretary of the company, is here looking after the matter.

Schenectady, N. Y.—The officials of the Schenectady Railroad Company are considering the advisability of running a line from the General Electric Works to the intersection of Albany.

Troy, N.Y.—It is understood that experts in the employ of the Delaware & Hudson Company have been preparing plans for equipping a portion of the system with electric facilities for motive power. It is stated that the side trolley will be used, so that operation by steam would be possible.

Washburn, Wis.—There is a movement on foot to build an electric car line from Washburn to Barksdale, which is the name of the new station five miles below the city, where the Atlantic Manufacturing Company has located its large plant for the purpose of manufacturing powder, dynamite and other high explosives.

Wheeling, W. Va.—The Pan Handle Traction Company has applied for a franchise to build trolley lines through this city.

Worcester, Mass,—It is reported in financial and street railway circles here that the Consolidated Railway Company, which is the name under which the New York, New Haven & Hartford Railway Company is operating its street railway lines, is to begin shortly the construction of the much talked of electric railway between Central Village and Norwich, Conn, this line completing a belt in Eastern Connecticut and supplying the missing link in 60 miles of trolley between Worcester and New London.

POWER PLANTS.

Atlanta, Ga.—The work on the big dam of the Atlanta Water & Electric Power Company across the Chattahoochee River at Bull Sluice has been completed. The pole lines for the transmission of the current have been brought up to the city limits. These lines, having been built on the latest and most approved plan, provide against all contingencies and interruptions and will deliver the current to the Georgia Railway & Electric Company, which has contracted for the entire power made at the new dam.

Hartford, Conn.—Thomas C. Perkins, of this city, has bought the controlling stock of the Windsor Locks Electric Light Company and intends to greatly enlarge and improve the plant and increase the water power.

Sheboygan, Wis.—An electric lighting and power plant is te be erected in this city by the new Elkhart Trolley Line Company.

BIDS WANTED.

Washington, D. C.—The Treasury Department, office of the Supervising Architect, will receive sealed bids until September 21, for the installation of a conduit and electric wiring system for the United States Custom House and Post Office at Nashville, Tenn. Address James Knox Taylor, Supervising Architect.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12⅝@12¾c.; casting, 12⅜@12½c.

The Philadelphia Traction Company has declared a dividend of $2 a share, payable October 1.

August earnings of the Massachusetts Electric system this year compared with last increased $30,000.

The Electric Boat Company has declared the regular quarterly dividend of 2 per cent. on its preferred stock, payable October 1.

Jas. Parmelee, president of the National Carbon Company, denies the report that the board will declare a dividend on the common stock.

The General Electric Company has declared a regular quarterly dividend of $2 per share, payable October 15 to stock of record September 17.

The Kings County Light & Electric Power Company has applied to the New York Stock Exchange to list $1,250,000 additional capital stock.

The Westinghouse Electric & Manufacturing Company has applied to the New York Stock Exchange to list $2,469,550 additional assenting stock.

The Boston Suburban Electric Company has declared the regular quarterly dividend of 50 cents a share on its preferred stock, payable October 15 to stock of record September 10.

A quarterly dividend of 1½ per cent. on the stock of the Manhattan Railway Company of this city will be paid on October 1. Books close September 16 and reopen October 28.

The Boston Elevated Company reports a record breaking month in August. Gross earnings were just a shade under $1,100,000 which was a gain of $133,000 over August last year.

The United Traction & Electric Company of New Jersey has declared the regular quarterly dividend of 1¼ per cent., payable October 1. Books closed September 13 and will reopen October 3.

Control of the Chicago City Railway Company has been offered the Union Traction reorganization syndicate for $250 a share, or a working minority at $225 a share. The reorganization syndicate offered $200 for the control.

The earnings of the Montreal Light, Heat & Power Company for the first three months of the current year, dating from May 31, will show an increase over that of the corresponding period for 1903 of from 30 to 40 per cent.

The Massachusetts Railroad Commissioners have authorized the Conway Electric Street Railway Company to issue $64,000 additional stock for the purpose of acquiring the property of the Conway Electric Light & Power Company. The stock will be sold at $100 per share.

The unsold balance of the original holdings in Philadelphia Rapid Transit of the W. L. Elkins estate has been sold to New York interests. The original holdings are understood to have been about 50,000 shares, of which about 15,000 were previously sold. The price paid is understood to have been 15.

Metropolitan Securities of this city is still a mystery in financial circles. The latest from Thomas F. Ryan, one of the managers of the syndicate, is as follows: "It is utterly untrue that the Morton Trust Company has paid $100 a share for the control of the Metropolitan Securities Company, or that the latter has been merged with the Interborough."

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Sept. 12
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	156¼
Metropolitan Street Railway	121
Metropolitan Securities	81½
Ninth Avenue	197
Third Avenue	123¼
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	54⅛
Public Service Corporation (New Jersey)	98
Philadelphia.	
Consolidated Traction of New Jersey	71½
Philadelphia Traction	97¾
Union Traction	56½
Boston.	
Boston Elevated	150½
Massachusetts Electric Companies, com	11½
do. do. do. pref.	58½
West End Street, com	91⅞
do. do. do. pref.	111¼
Chicago.	
City Railway	190
North Chicago	71
Union Traction, com	7½
do. do. pref.	37
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	11½
do. pref.	50
Electric Boat, com	40
do. do. pref.	66
Electric Lead Reduction	¾
Electric Vehicle, com	15
do. do. pref.	20
Westinghouse, com	164
do. pref.	180
General Electric	172
Boston.	
Edison Electric Illuminating	260
General Electric	172½
Westinghouse Electric & Mfg., com	80
do. do. do. pref.	90
Chicago.	
Chicago Edison	150
National Carbon, com	35¼
do. do. pref.	109
Philadelphia.	
Electric Company of America	9⅝
Electric Storage Battery, com	67
do. do. do. pref.	67
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140
Western Telephone Company	14
New England Telephone Company	123¾
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	210
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	91¼
Miscellaneous.	
Chicago Telephone Company	122
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	85
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

The Independent Telephone Convention.

The Independent Telephone Association of the United States holds the first session of its annual meeting in St. Louis to-day (September 21). It is expected that an unusual number of delegates will be in attendance, owing in part to the opportunity that will be afforded them of visiting the World's Fair and to the growth of the Association.

As usual a number of interesting papers are to be read and discussed. The Independent situation as it is to-day will be explained and the progress which has been made during the past year by the Independents against the monopoly cannot help but be gratifying to all those who have at heart the welfare of the Independent movement.

We would call the attention of our "Independent" friends to our annual cartoon which will be found on page 157 of this issue.

* * *

The International Electrical Congress.

The International Electrical Congress, held in St. Louis, has just drawn to a close. The last meeting was held on Friday.

The Congress may be said to have been eminently successful. Over 500 members were present and many papers of scientific value were presented.

During the second day's session the important question of international measurement standards was taken up and carefully gone over. It was finally decided to appoint two committees with a view to reaching an agreement—one to deal with the fundamental unit question and the other to take up the practical standardization of sizes in electrical machinery.

Such an international agreement and understanding will be of incalculable value to the electrical industry throughout the world.

Besides the question of international standards other important questions were brought up—so many in fact that we are unable to mention them in these columns. A detailed account of the proceedings will be found elsewhere in this issue.

* * *

The Cheap Generation and Distribution of Industrial Electricity.

One of the most valuable among the many electrical papers read before the Cambridge meeting of the British Association was that on "The Use of Electricity on the North Eastern Railway and Upon Tyneside," by Mr. Charles H. Merz and Mr. William McLellan. It was shown that in the district referred to the adoption of electricity for motive power for all classes of work has been so rapid during recent years as to have a material effect on the industrial conditions there prevailing. The reasons which prompted the North Eastern Railway Company to undertake the electrification of its lines were stated, and the nature of the problems that were faced in the carrying out of the work described. An account also was given of the generating station and its equipment, but most of this was already known, having been published in other places. Some interesting remarks were made respecting the special features of the railway electrification problem in England. It was shown that apart altogether from considerations which may be peculiar to main line railways, the standard permanent way construction adopted in England, the type of ballast, the small clearances at tunnels and stations, the short distance from running rail level to load gauge, and the high degree of humidity of the atmosphere, are among the special features affecting English railways

which render the problems to be solved in the design of details in connection with the insulation and feeding of the conductor rail, and bonding, different from, and more difficult than, those which have been encountered elsewhere. The sectionalizing of the third-rail, the anchoring to provide for expansion, the protection which is in certain cases necessary, are all questions which require to be specially solved to meet each individual case.

The North Eastern electrification scheme practically provides the railway company with electrical energy anywhere in the Newcastle district from the Newcastle-upon-Tyne Electric Supply Company. Apart from the electrical working of the railway, there are already in use, or shortly will be, 1,000 arc lamps, 20,000 incandescent lamps and 100 motors, aggregating over 2,000 hp., stationary motors being used for driving the various works, and also for capstans, cranes, etc., in the goods warehouses and yards. For this supply of energy the railway company pays at the rate of 2 cents per unit or under. Besides the railway station at Newcastle, and the large yards in the immediate neighborhood, there are over thirty passenger stations which will be lit electrically when the scheme which is gradually coming into operation, is finally complete. The chief locomotive works of the company at Gateshead, all the engineering department and offices, and the carriage repair shops at Blaydon, Heaton and Percy Main are also electrically driven and lighted. The North Eastern has five substations of its own fed from the Newcastle Supply Company's generating station at Carville. These substations have an aggregate capacity of 15,000 hp. Except in cases where direct current lighting had previously existed, the system adopted throughout has been to transform high tension (6,000 volts) three-phase current to low tension three-phase at a voltage of 440 between the outers, giving practically 250 volts to the neutral point—incandescent lighting, arc lighting and motors being supplied from the same transformers. The advantages of this system are, first, the power and lighting is independent of short circuits on the third rail; second, the supply for power and lighting is entirely independent of any revolving machinery; third, the pressure regulation is automatic, and fourth, the induction form of motor can be used without any commutator slip rings or brushes of any kind.

The authors said that in cases where the electrification of a particular works or section of line had been decided upon, it was evident that on economic grounds alone it was correct to combine the generation of power with that for the other requirements of the neighborhood. This applies more particularly, of course, to English conditions, where industrial centers are situated within a few miles of each other; they are not, as a rule, so located in America. It was further argued that if large power users, railway companies, and manufacturers would look at the matter in a comprehensive and broad-minded way, and if continued municipal restrictions be not placed upon the industry, rapid progress would be made in the direction of the wholesale distribution of electrical energy at a low price, bringing with it enormous industrial and social advantages.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A congress to discuss the Roentgen methods will meet in Berlin April 30, 1905. Prof. Roentgen will be the guest of honor of the congress, which marks the tenth anniversary of the publication of his discovery.

Signor Marconi arrived in New York on Sunday on the steamer Arabic. He said his visit here is principally to inspect the wireless service on the Cunard line steamships. He also will inspect the Cape Breton station.

Mr. J. J. Lyle, New York, secretary of the Engine Builders' Association, informs us that the next meeting of the association will be held in this city, December 2 and 3 next.

Reports as to the failure of the Curtis turbine to give satisfaction are declared to be untrue and General Electric interests claim such reports emanate from rival concerns.

For more than a year 300 men have been engaged in the construction of what will be one of the largest electric and gas plants in the United States on the Hackensack (N. J.) meadows. It will furnish light, heat and power to Newark, Jersey City and other near-by towns. The probable cost has not been made known, but it will reach $1,000,000 at the least.

An international electrical exposition will be held, under the auspices of the Electrical Contractors' Association of New York City, at Madison Square Garden, December 19 to 28. The executive committee is composed of Joseph R. Strong, chairman; E. S. Keefer, E. K. Comstock, J. P. Hall, J. C. Hatzel, S. Davis and G. W. Russell, Jr.

In equipping the West Shore Railroad with electricity the Andrews-Stanley-New York Central combination will utilize Niagara Falls power for the western end and Trenton Falls power for the eastern branch. Syracuse will be the dividing point.

Negotiations are proceeding between the German and Swiss Governments with reference to the utilization of the Rhine at Laufenburg for generating power in connection with the extension of the Rheinfelden works. In the course of this enlargement, says the *Electrician*, London, use is being made of an island in the Rhine, and as at this point the river forms the boundary between the two countries, the works will be situated partly in each. This will be the first international convention for the regulation of electric power.

The Metropolitan Street Railway Company of this city has adopted a new automatic switch which is to be installed in place of the antiquated devices that are new operated by hand by switch tenders. The new switches will be operated by the motormen from their car platforms. The first of the new switches is to be put in at 23d street and 6th avenue.

The twenty-third annual meeting of the American Street Railway Association will be held October 12 and 13 on the second floor of the Transportation Building, Exposition Grounds, St. Louis. Papers will be presented on the following subjects: "Steam Turbines," "Reciprocating Engines," "Gas Engines," "Transfers, Their Uses and Abuses," and "Signals."

The Interborough Rapid Transit Company of New York will soon equip all elevated trains with a new automatic brake, now being installed on the subway, designed to lessen the danger of the sudden death of a motorman or his falling asleep. The brake used on the elevated system at present shuts off the power, but nothing more. It does not, of course, do away entirely with the danger of a collision. The new brake is designed to avert this danger. The motorman is required to keep his hand on the lever continuously. The moment his hand leaves the controller the power is shut off and the air brakes set.

THE NATIONAL INDEPENDENT TELEPHONE ASSOCIATION CONVENTION.

The annual convention of the Independent Telephone Association of the United States, to be held at the Inside Inn, World's Fair Grounds, St. Louis, will open to-day (Wednesday) and will be in session Thursday and Friday. Secretary Jones predicts that at least 2,000 delegates will be present.

President Francis of the Louisiana Purchase Exposition will deliver an address of welcome, which will be responded to by Hon. Hugh Dougherty, president of the Independent Telephone Association of the United States.

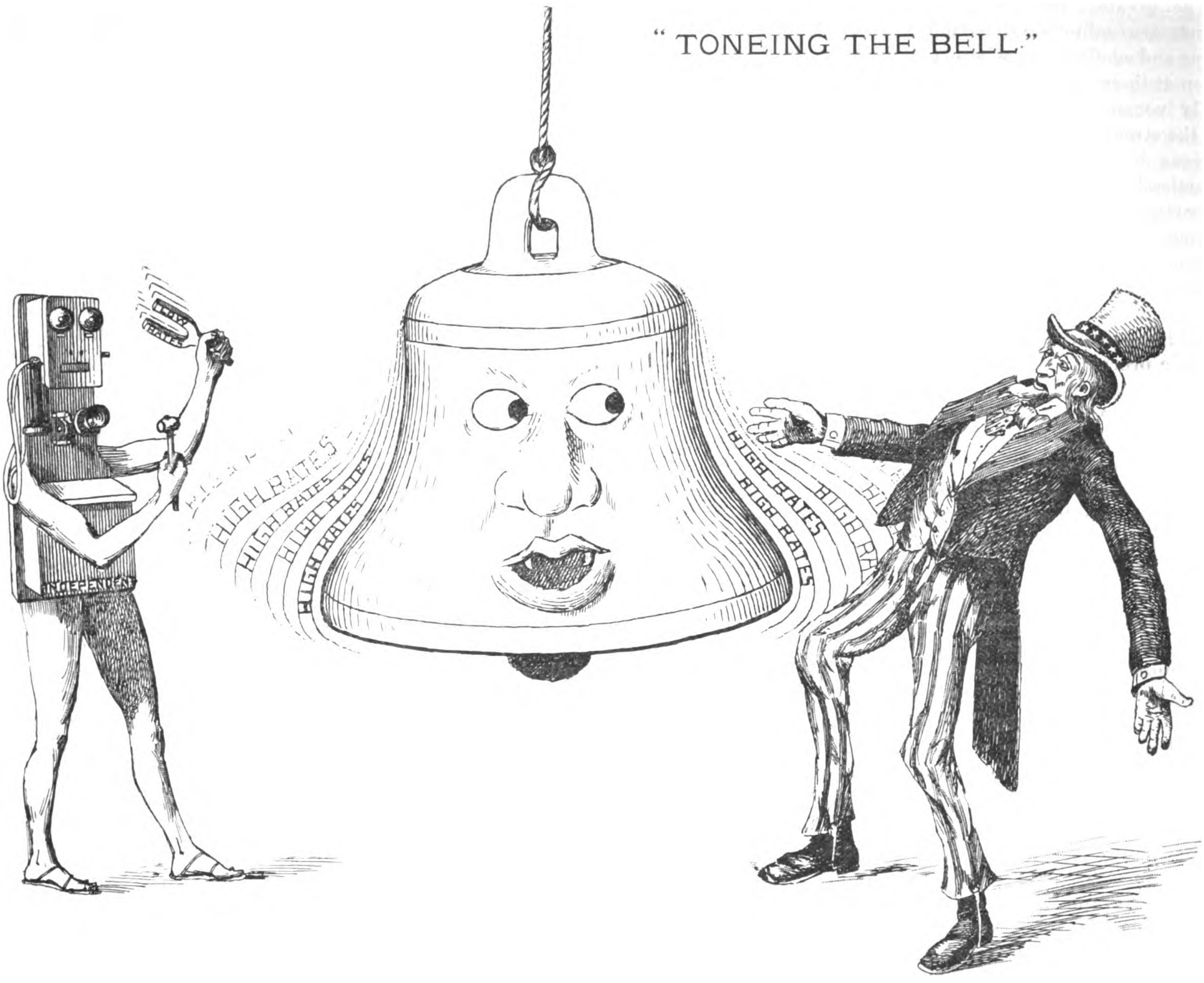
Papers will be read by Prof. J. C. Kelsey, Messrs. James B. Hoge, Edward L. Clement, Frederick S. Dickson, S. G. McMeen and C. E. Wilson.

The reports of officers and committees will be made on Friday, when the election of officers will take place.

THE LIMITATIONS OF THE TELEPHONE FOR FIRE ALARM PURPOSES.*

BY ADAM BOSCH,
Newark, N. J.

The great benefits derived from the use of the telephone in the business management of the fire departments of the larger cities cannot well be overestimated. By no other agency can the same facility of intercommunication between the different units of a fire department be attained.



"TONEING THE BELL"

"THE EXPOSURE."

While this is universally acknowledged its use as a substitute for the fire alarm box has met with little or no favor from those in charge of fire alarm systems, and its advocacy is principally in the hands of those identified with the telephone interest.

The reasons advanced by those favoring the use of telephones for fire alarm purposes are mainly based on the fact that the number of telephones in use in any locality far exceed the number of fire alarm boxes, and that by reason of this, in case of fire, a telephone would always be more quickly available than the more sparsely distributed fire alarm box. The latter could consequently be dispensed with, which would result in considerable saving to municipalities. They claim also greater efficiency for the telephone, inasmuch as a person may not only give a notice of fire, but also, at the same time, inform the fire department of its nature and extent.

In how far these claims for the telephone are sustained by facts, and where it fails to meet the diverse requirements of fire departments in village, town or city, is the subject of this paper.

That fruitful subject for discussion, the delays, mistakes and poor service generally charged against the telephone central office, will not be considered, for such troubles are local and incidental, and the

*Paper read at the ninth annual meeting of the International Association of Municipal Electricians, held at St. Louis, Mo., September 13-14, 1904.

companies are daily giving proof of their desire and success in minimizing them. Only such objections to the use of the telephone for fire alarm purposes shall be made as I deem to be inherent in the telephone or telephone system, when considered in relation to the fire alarm service.

The conditions of fire departments in village, town and city are not the same and their requirements in regard to an efficient fire alarm are different.

The greatest number of fire departments are volunteer departments in villages and small towns where the firemen sleep at their own homes, and follow their daily vocations in the store, factory, or on the streets. A statement of these conditions is sufficient to prove that it is practically impossible to summon such a department to a fire by means of the telephone. It might be contended that telephones could be used to notify some factory to blow its whistle or some church janitor to ring his bell, but this would manifestly be a slow and very uncertain process, especially at night. Contrast this with the promptness of the fire alarm box. Almost before the person giving the alarm can remove his fingers from the hook any desired number of bells may strike or steam whistles blow, automatically and simultaneously, giving to the firemen the exact location from whence the alarm proceeds.

Next in number are the partly paid fire departments where usually only a sufficient number of men are permanently appointed to each company to take their apparatus to the fire; the rest are "call" men; such a company responding to a telephone alarm of fire would be powerless on their arrival until reinforced by the call men, who could not be promptly summoned by telephone.

Next come the fully paid fire departments in cities having an automatic fire alarm telegraph. Here every engine and truck company is permanently assigned to respond to alarms from certain boxes. On completion of the first round from a box the horses are hitched to the apparatus and the men are on their seat ready to leave quarters. How slow in comparison with this would be the response to a telephone call to each company. Of course anyone having a telephone may, on the discovery of a fire, call an engine or truck company, and the apparatus summoned may be able to put out the fire, but some very disastrous fires have occurred where this has been permitted. A fire is an unknown quantity until put out, and the discoverer of one is seldom a judge of what is required to extinguish it. To permit this to be done is to invite disaster. In the permanent assignments the relative number of engines and trucks to certain boxes is made with a view to the possible requirements of the neighborhood in which the boxes are located.

On receiving an alarm from any box every company knows instantly whether they must respond or not; no verbal instructions are required. I cannot see how a telephone system could be devised to accomplish this with anything approaching the automatic fire alarm system in reliability and promptness.

In the larger cities, having a manned fire alarm system where operators are in constant attendance, the case is somewhat different. The operator may receive a notice of fire by telephone and transmit it manually on the gong circuits the same as one received from the box, but not so expeditiously; he must obtain from the person on the other end of the telephone either the name and number of the street or his telephone number; if the former he must consult his map, and if the latter his telephone list, in order to determine the nearest box station before the alarm may be transmitted, and in this way much valuable time is lost. The information an operator obtains in this way is often fragmentary and imperfect, as the tendency in an excited person appears to be to yell into the transmitter the fact that there is a fire and then leave the telephone. To call the person back for further necessary information is often attended with great difficulty and sometimes impossible.

In the development of the fire alarm box it has been the constant endeavor of the manufacturer to eliminate the personal equation from its operation as much as possible. In this he has succeeded in a remarkable degree, for it is hardly possible for any one to make a mistake in operating a box. No matter how low the intelligence of one person, or how great the excitement of the other, both will operate the box with equal facility, and the operator need not, as he would under equal circumstances receiving a telephone alarm, struggle with the one and gradually draw from him the necessary information, or waste precious time cooling down the excitement of the other. The box has this further advantage—we may have a record of its operation for verification as well as for preservation.

In the use of the telephone for fire alarm purposes the personal equation enters very largely. Giving a notice of fire by telephone is a matter between the discoverer of a fire, the operator at the telephone central and the operator at fire alarm headquarters, with no record for verification. That misunderstandings and mistakes are more liable to occur under such conditions than when the alarm comes from a fire alarm box will be readily granted.

Some persons voices are not well adapted for telephone conversation and others have defects of speech. Add to this the excitement incident to the discovery of a fire and we can easily understand why an operator is not in a very happy state of mind when receiving a telephone alarm. To fully realize this one must have encountered an excited Italian on the other end of the telephone trying to call the fire department.

In the transmission of an alarm from a signal box there is no unknown quantity of time—its action is instantaneous. In the problem of the transmission of an alarm of fire by telephone a number of unknown quantities of time exist: The time consumed by the sender to obtain the attention of the central, the time required by central in making connection with fire alarm headquarters and obtaining the attention of the operator, the time consumed by operator to obtain particulars about location of fire, and finally the time required by operator to determine by reference to his map or telephone list the number of the nearest signal station to the locality. Theoretically some of these unknown quantities may be very small.

There are other and weighty reasons which absolutely limit the use of the telephone for fire alarm purposes.

On holidays and at night when stores and factories are closed most fires are discovered from the outside by the police or passing citizen. At such times telephones are not available, but the nearest street box is always accessible. The same conditions exist in the residential sections at night.

From the foregoing considerations we may safely draw the following conclusions:

That in a volunteer or partly paid fire department the use of the telephone is entirely impracticable.

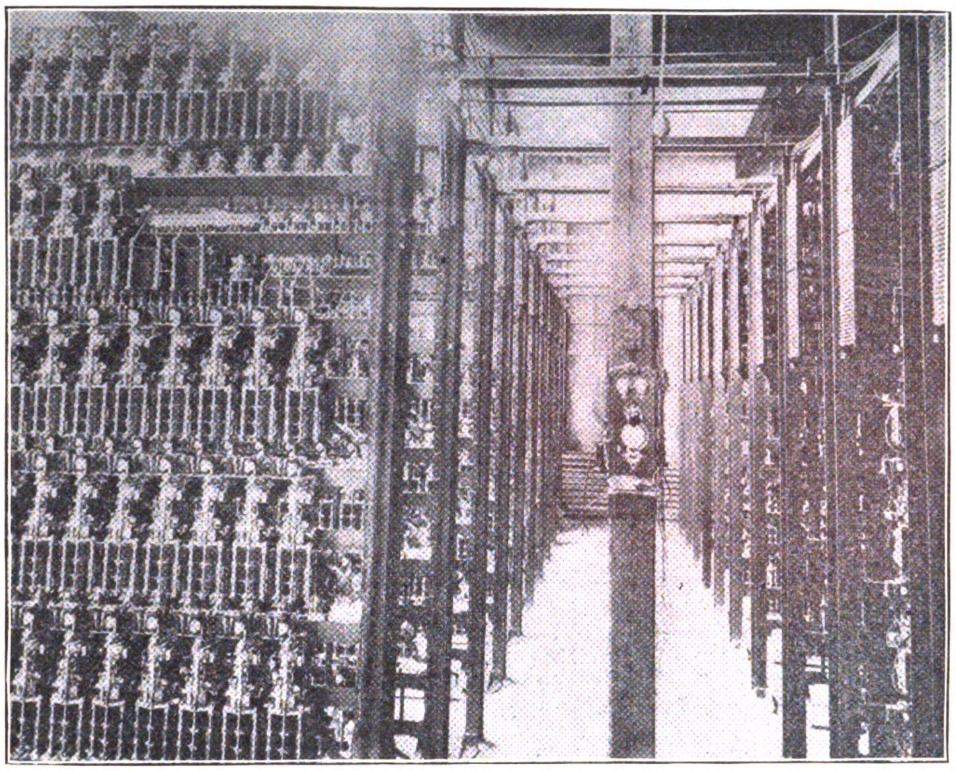
That in a fully paid fire department with an automatic fire alarm telegraph system the telephone as a means of giving alarms of fire is impracticable unless operators are constantly in attendance to transmit these alarms to department. The cost of this would in many cases be prohibitive, and the results in promptness and reliability would not equal the results derived from the use of fire alarm boxes unless the latter were an unreasonably long distance apart.

THE NEW AUTOMATIC TELEPHONE EXCHANGE AT PORTLAND, ME.

BY FRANK C. PERKINS.

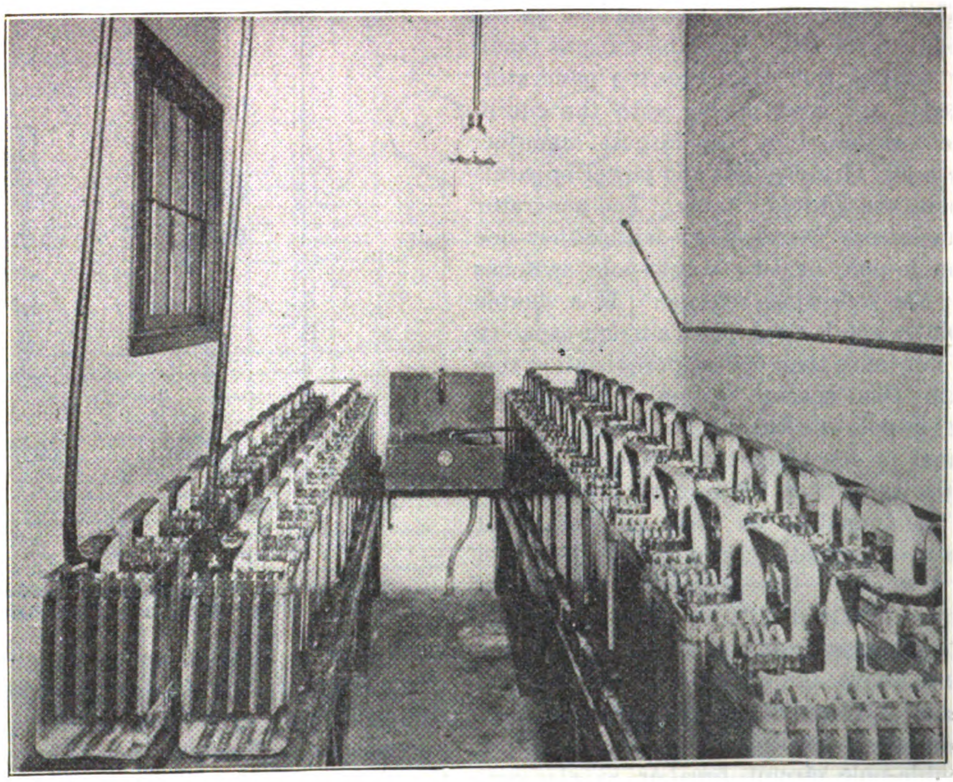
The accompanying illustrations show the automatic switchboards and electrical equipment of the Northeastern Telephone Company's new exchange recently installed at Portland, Me., and the vice-president and general manager, Mr. Louis A. Goudy, reports most favorably upon the secret service 'phone installed in that city.

The basement of the three-story building is equipped with the necessary steam heating apparatus, and contains a fire-proof room with a large vault as well as fire-proof tunnel for the conduit system, while the first floor is utilized for the business offices, long-distance telephone booths and reception rooms. The storage battery room, testing room and distributing racks are located on the second floor, with space for an equipment for 8,000 subscribers, or a sufficient area for 3,000 subscribers in excess of the 5,000 accommodated on the third floor. The third or top floor is equipped with racks to accommodate 3,000 switches or secret service telephone connections, with 2,500 already installed for immediate connection, with surplus room for 2,500 more, making a capacity of 5,000 subscribers. The automatic exchange building of the Northeastern Telephone Company has a total floor space of 10,000 feet, with a ground area of nearly 4,000 feet. The switchboards noted in the illustration include three tiers of 10 boards in each tier, each of which represents 10,000 subscribers. Additional shelves with 25 switches on each shelf may be added to increase the exchange for a much larger number of subscribers.



Automatic Switchboard of the Northeastern Telephone Company.

The power installation of this automatic exchange is provided in duplicate, two sets of storage batteries being employed, each consisting of a series of 26 cells. One set has a capacity of 200 ampere hours, and the other an output of 300 ampere hours, the elements of the accumulators being supported on a stand and insulated with porcelain knobs. The charging machines are of the General Electric type with a pressure of 75 volts directly driven by a 60 cycle, two-phase alternating current motor. One of the ringing outfits consists of a two-phase 60 cycle motor directly coupled to a Holtzer-Cabot ringing machine, the current being supplied from the local power circuit, while the other ringing set consists of a motor generator driven by current from the storage battery plant.



Battery Room of the Northeastern Telephone Company.

A telephone system was installed in the city of Portland more than two decades ago, the Dirigo Telephone Company of Maine claiming to be one of the oldest, if not the oldest, Independent telephone companies in America. Two years ago the Northeastern Telephone Company was organized, this name being taken in place of the one above mentioned, and it now has in operation nearly 200 miles of trunk line connecting nearly four score of cities, towns and villages in Northwestern Maine with nearly 100 pay stations, and at least a dozen exchanges in addition to the automatic exchange at Portland. This system is claimed to be absolutely automatic and secret as carried on along the 7,000 miles of wires with their rural line connections. The automatic switches are mounted on iron racks of 10 to a section, each containing 100 switches, or a total of 1,000 switches to each section. The exchange

building cost about $40,000, exclusive of its automatic switchboard and equipment. A total of nearly half a million dollars has been spent in Portland during the past year by the Northeastern Telephone Company. The conduit and underground cable construction extends through about 11 miles of the street with between 300,000 and 350,000 feet of duct, and more than 7,000 miles of cable and aerial wire has been installed in Portland alone.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

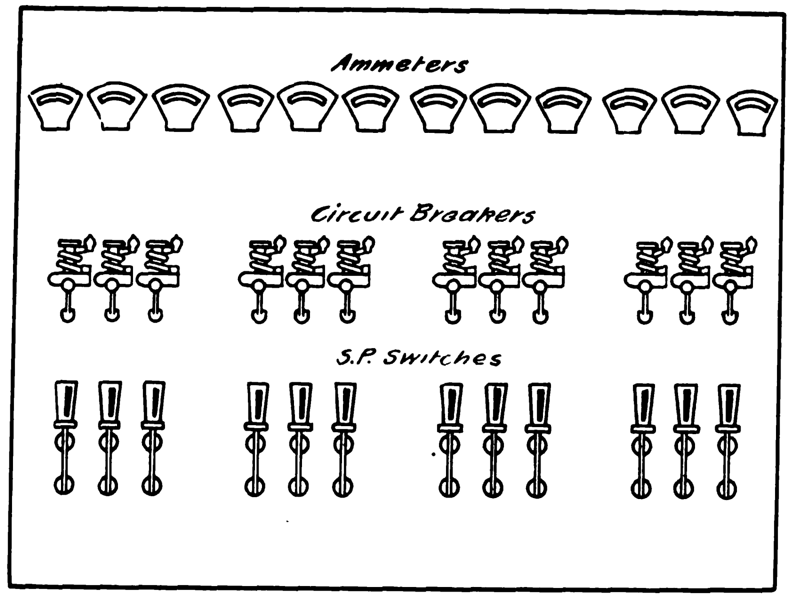
(*Continued from page 145.*)

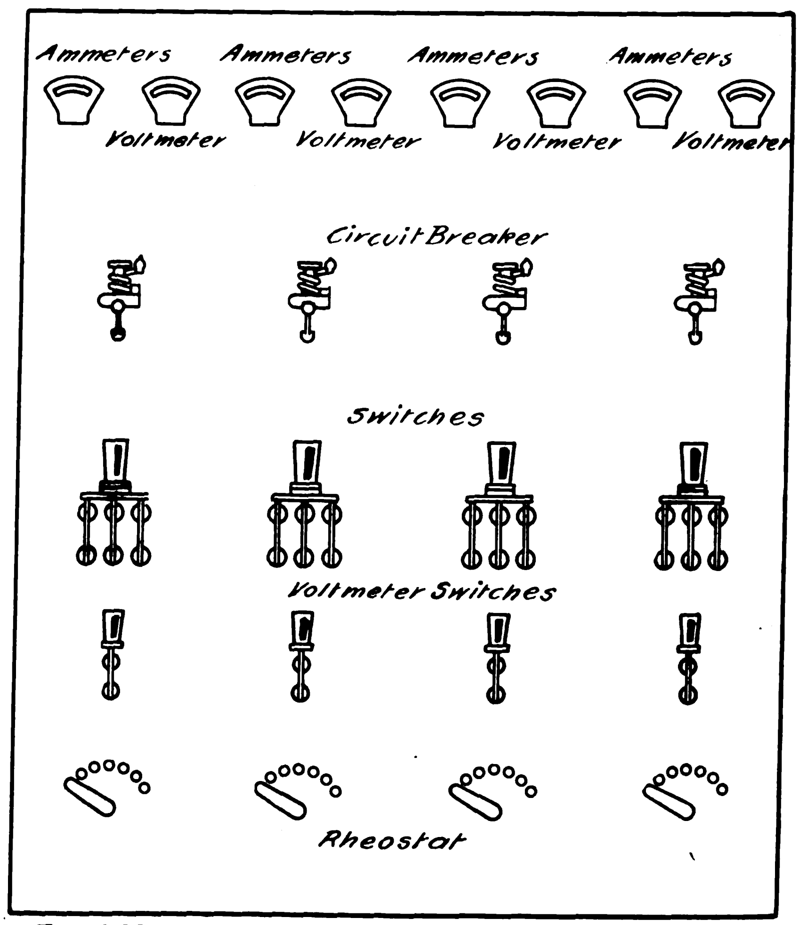
Panel Switchboards.—The panels composing the essential parts of a switchboard, such as the generator panel, load panel and feeder panel, call for the further classification of switchboards with reference to these facts.

In street railway service particularly the two great divisions of apparatus and parts of the switchboard are the generating section and the feeding section. Dividing the switchboard up into panels is convenient in a practical sense and very instructive from a technical standpoint. All the apparatus relating to the generator, covering the instruments previously named, are placed on one panel, as shown in the sketch. When large switchboards are erected, the generator panels are placed on the right hand side, the feeder panels on the left.

It is customary to place the load panels between the two. The illustrations readily convey this idea, showing generator, feeder and load panels with the equipment supplied by the largest manufacturers of electric light and power apparatus in the United States. The generator panels may be supplied with either one double-pole or two single-pole switches for the following reasons: If a double pole switch is employed a current capacity of not more than 600 amperes is allowable with this special design. When two single-pole switches are supplied the panel is constructed to have a current capacity of from 800 to 2,000 amperes.

The ammeters on these panels are all made of a greater capacity than the panel as a whole. The possibility of a continued overload calls for the employment of ammeters reading as high as 50 per cent. above the rated capacity of the panel. Where the generator panel has a double-pole switch mounted on it a double-pole circuit breaker is also employed. The load panel carries an ammeter and a voltmeter. This voltmeter is used to give the bus bar reading ordinarily or it is indispensible where another generator is to be put in multiple. In this case it acts differentially, giving the *difference* between the pressure of the generator and the bus bars, as previously described. A recording wattmeter giving the total external consumption of amperes or watt hours is also connected below in culable value. The first and back view of a feeder panel is shown, with the lightning arresters in place. The appearance of a panel switchboard consisting of two generator panels, one load panel and three feeder panels is shown, carrying out the idea of placing the generator panel towards the right, the feeder panels





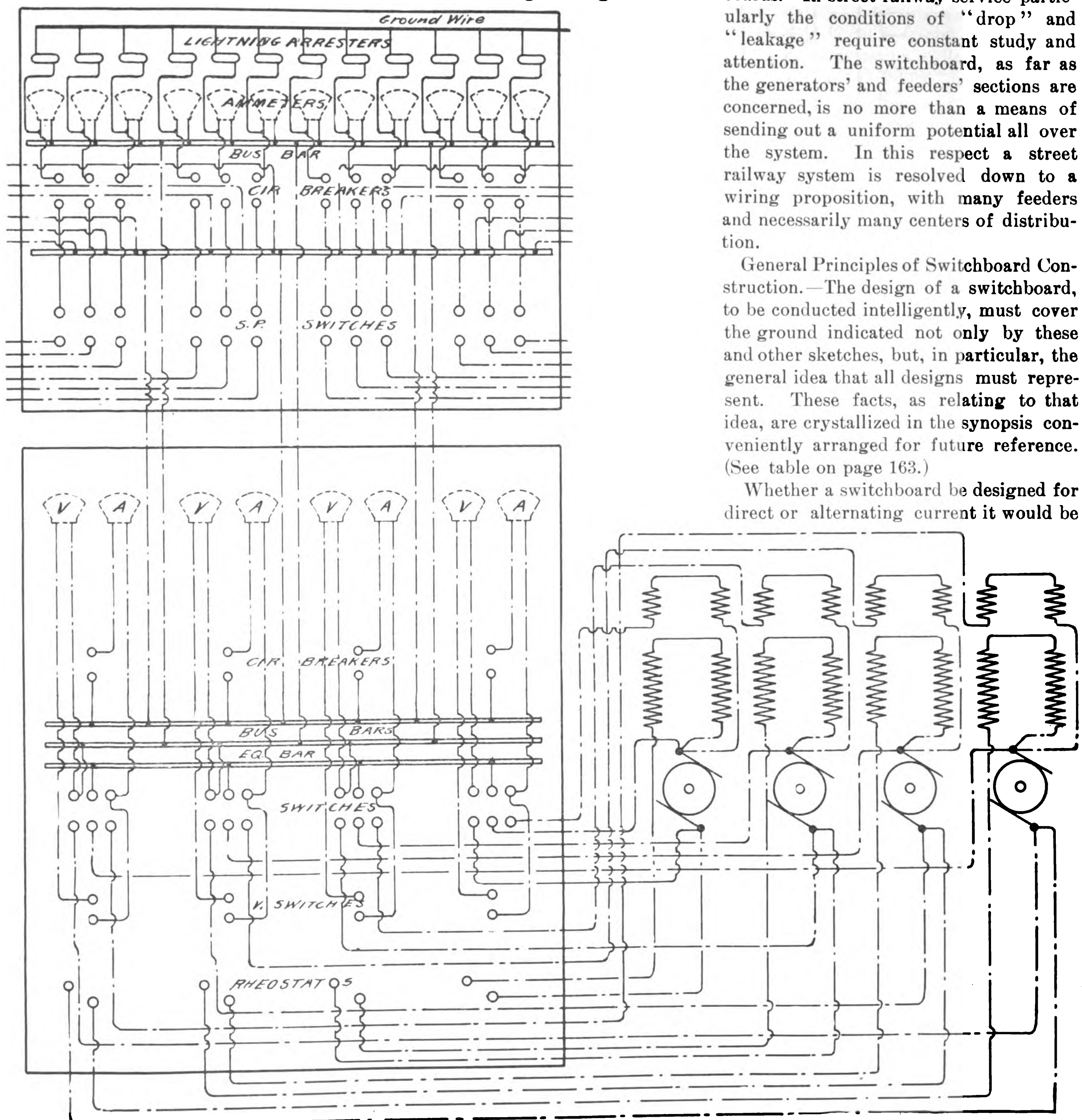
Front View of Generator and Feeder Switchboard.

many cases. The feeder panel, with its single-pole switches and ammeters, circuit breakers and lightning arresters (frequently mounted on the back), represents the distributing department of a large switchboard. In street railway service this system of designing and connecting switchboards has proved a matter of incal-

toward the left and the load panel between.

Street Railway Switchboard.—The ideas carried out by the preceding series of principles relating to switchboards are embodied in the illustrations showing the connections of three compound wound generators operating in multiple to feed a

street railway system. The front view of the switchboard really represents two switchboards, which might be called the primary or generator board in compliance with the last proposition relating to this classification; the other, the secondary wiring plan of this switchboard is laid out from the generators to the generator board and then to the distributing section. It is a well-known fact that in street railway service the trolley line is reinforced during its entire length at regular inter-



Back View of Generator and Feeder Switchboard, Showing Dynamos in Multiple.

switchboard, would necessarily be called the distributing or feeder board. In many stations the upper one is mounted on a platform above the first with a passage way for the attendant.

A new feature to the reader is the upper line of lightning arresters protecting the outgoing feeders. The entire complexity of the switchboard is entirely due to the multiplicity of circuits. The key to the situation is a careful study of the fundamental principles underlying the theory and construction of switchboards. In street railway service particularly the conditions of "drop" and "leakage" require constant study and attention. The switchboard, as far as the generators' and feeders' sections are concerned, is no more than a means of sending out a uniform potential all over the system. In this respect a street railway system is resolved down to a wiring proposition, with many feeders and necessarily many centers of distribution.

General Principles of Switchboard Construction.—The design of a switchboard, to be conducted intelligently, must cover the ground indicated not only by these and other sketches, but, in particular, the general idea that all designs must represent. These facts, as relating to that idea, are crystallized in the synopsis conveniently arranged for future reference. (See table on page 163.)

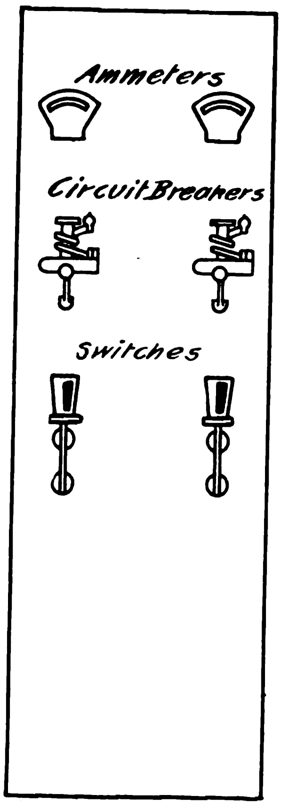
Whether a switchboard be designed for direct or alternating current it would be

vals by connection with a system of feeders. By this means the pressure is kept at its normal value along the route and the speed of the cars preserved. Both track and trolley line are dependent upon this feeding system, which does not materially differ from that employed for incandescent lighting. The apparent

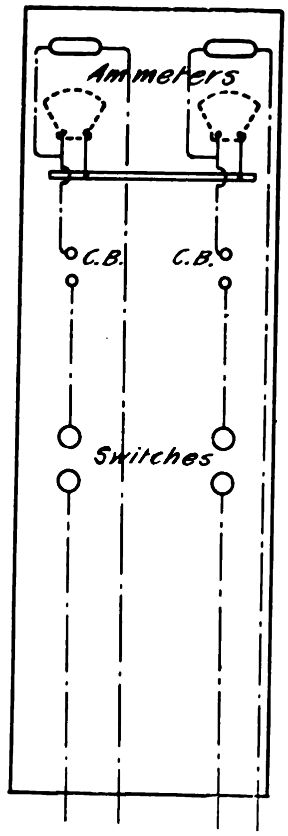
wise to consult some such plan as the above before proceeding to lay out the apparatus and circuits. For switchboards for incandescent lighting and street railway service a departure could not be made from the system indicated.

Lightning Arresters.—Lightning arresters are employed for the protection

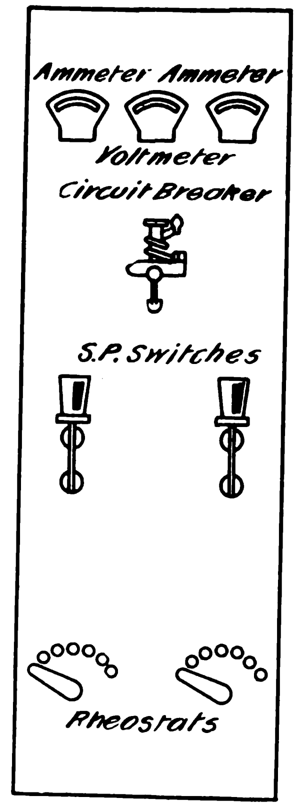
of alternating as well as direct current circuits. The injury electric light and power circuits are exposed to under cer-



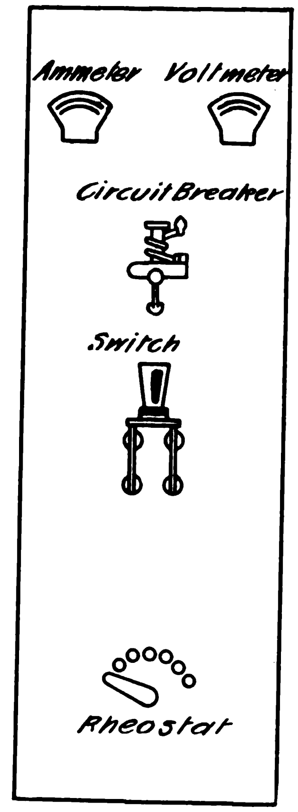
Feeder Panel.
(Front.)



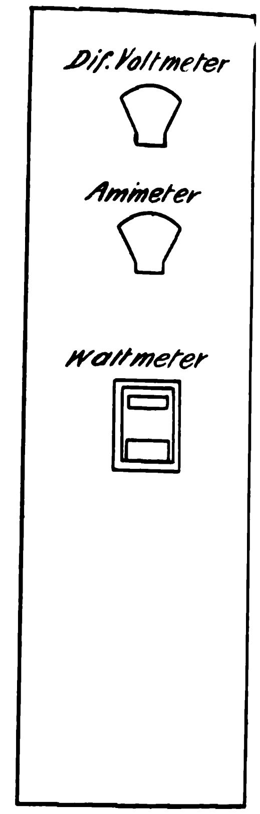
Feeder Panel.
(Back.)



Generator Panel.
(Two circuit.)



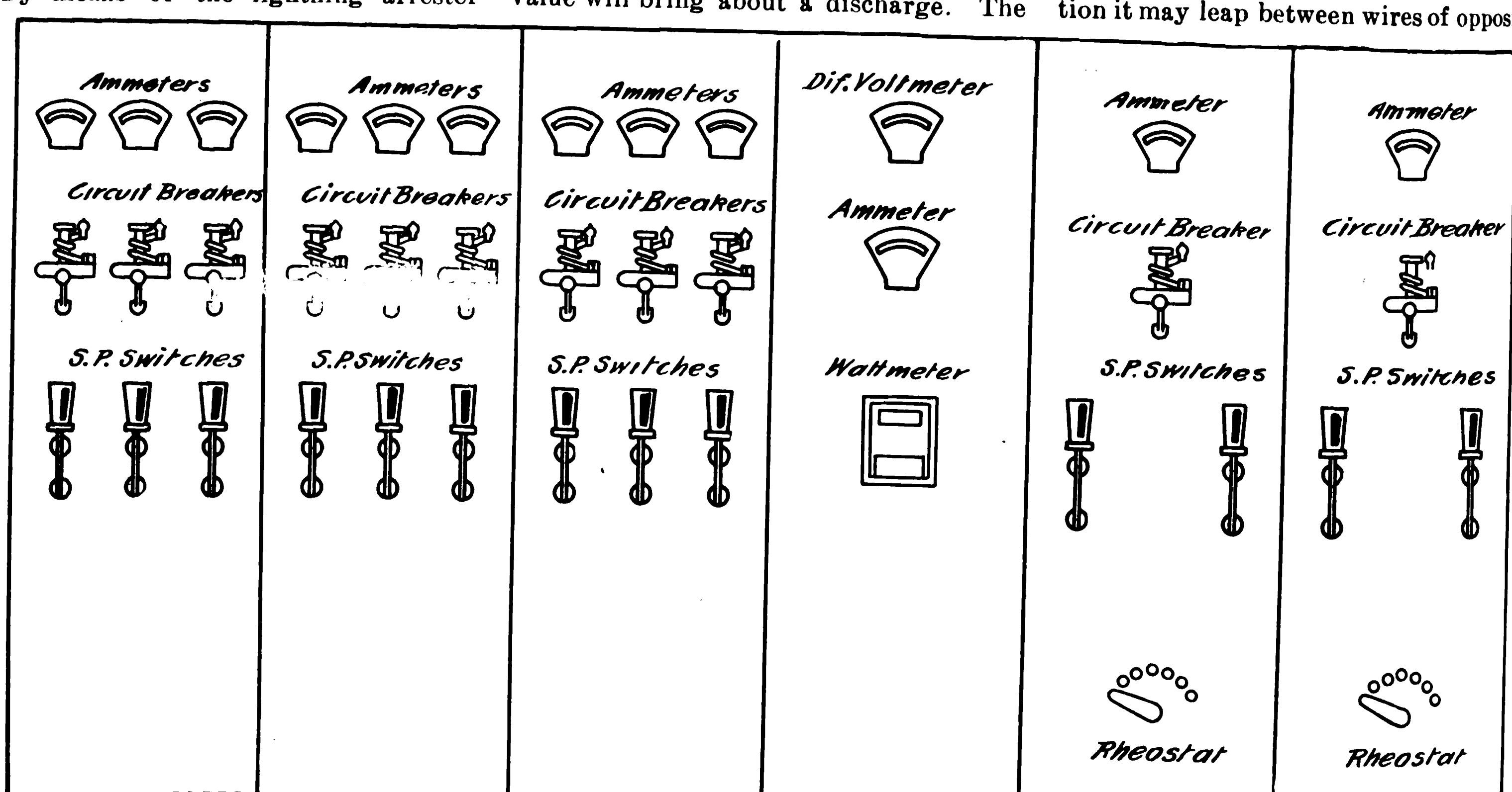
Generator Panel.
(One circuit.)



Load Panel.

tain conditions are, first, short circuits; second, grounds.

By means of the lightning arrester

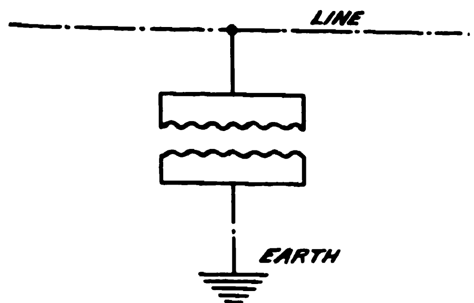


Panel Switchboard, showing Relative Position of Generator, Load and Feeder Panel.

protection against either of these breakdowns through lightning discharges is afforded. The lightning arrester offers protection against a sudden rise of potential in the lines by the use of, first, an air gap; second, a dead ground.

In well constructed lightning arresters the air gap can be so adjusted that a rise of voltage beyond a certain anticipated value will bring about a discharge. The danger arising in lightning arresters is due to the possibility of arcing. This will, in many instances, take place after an enormous burst of potential, which, leaping the gap leading to the earth, provides a gaseous path for the current of the generator unless the insulation is perfect. When lightning strikes a station unprovided with adequate protection it may leap between wires of opposite polarity, which wires, if near enough, will develop an arc. In several notable instances it was believed that lightning supplied the flame and the fire to destroy

the station. A little consideration of the direct possibility of a high pressure discharge causing an arc will readily account for the destruction of property which ensues. In such cases the station supplies the power with which to burn itself down. The line is therefore provided with a pressure vent whenever danger may arise through exposure to discharges of this character. This is merely an air gap



Principle of Lightning Arrester.

leading to the earth. Where a lightning discharge possesses a very high frequency it is well known theoretically and practically that the apparent resistance of a copper wire becomes so great that an air gap is preferable. On some such lines as this lightning arresters are designed for the protection of light and power circuits.

Table.

PRINCIPLE OF SWITCHBOARD CONSTRUCTION FOR SHUNT AND COMPOUND WOUND DYNAMOS.

Generating section.	Metering section.	Feeding section.
Switches.	Differential voltmeter.	Switches.
Circuit-breakers.	Ammeter.	Circuit-breakers.
Bus bars.	Wattmeter.	Bus bars.
Ammeters.		Ammeters.
Voltmeters.		Lightning-arresters.
Rheostat.		

New York Street Railway Association's Convention.

There was a large attendance last week at the 22d annual meeting of the New York Street Railway Association, held at Utica.

President Connette in his address spoke of the use of electricity on the New York Central lines as the beginning of the movement to supplant steam lines and also reviewed the subject of handling of freight on electric lines.

Papers were read by Messrs. M. G. Starrett, H. A. Benedict, C. R. Van Etten, J. B. Struble and W. J. Davis, Jr. The following officers were elected for the ensuing year:

President, C. Loomis Allen, Utica; first vice-president, J. H. Pardee, Canandaigua; second vice-president, A. B. Colvin, Glens Falls, and secretary, W. W. Cole, Elmira.

ON LARGE BULB INCANDESCENT ELECTRIC LAMPS AS SECONDARY STANDARDS OF LIGHT.*

BY J. A. FLEMING, M.A., D.SC., F.R.S.

(*Continued from page 150.*)

Dr. Glazebrook has made a prolonged study of the Harcourt pentane, 10 candle lamp in regard to variation of candle power of the latter with atmospheric moisture and pressure, the results of which he will no doubt make known in due time. Meanwhile he has privately communicated to the writer information which shows that the correction of the candle power in the pentane lamp, due to moisture in the air—or, rather, deviations from the standard state of moisture—is at least as great as that of the Hefner lamp. There seems reason to believe that this correction would be about the same for all flame standards. Dr. Glazebrook has been so kind as to communicate to the writer a formula for the correction of the pentane lamp for variation in illuminating power due to atmospheric moisture and pressure which he has obtained, but it must be considered as merely privately and unofficially furnished, and, therefore, subject to any future correction by him. Taking the Harcourt 10 candle, pentane lamp to emit a light of 10 cp. when the barometric pressure is 760 mm. and the atmospheric moisture 10 liters per cubic meter, then the candle power corresponding to a barometric pressure of b millimeters and a hygrometric state of e liters of water vapor per cubic meter, he finds that candle power can be expressed as follows: candle power of the Harcourt pentane lamp = $10 + 0.066\ (10 - e) + 0.008\ (760 - b)$. The water vapor present may often reach 15 or 16 liters per cubic meter. This variation alone will decrease the candle power by 3 per cent. or rather more. Hence, if the correction is not applied, and the pentane lamp is then used directly to standardize an incandescent lamp, and assumed to be 10 cp., the candle power of the electric lamp may be marked as much as 3 per cent. too high. In other words, an error of nearly 0.5 cp. may be made in marking a 16 cp. lamp. This source of error only presents itself in comparing a flame standard with an incandescent lamp. When two flame standards, such as coal gas and pentane are being compared, the atmospheric moisture affects both flames about equally.

(*To be continued.*)

* Paper read before the British Association at Cambridge, Eng., Aug. 22, 1904.

THE INTERNATIONAL ELECTRICAL CONGRESS.

The first meeting of the Chamber of Delegates of the International Electrical Congress was held at Music Hall, St. Louis, Mo., September 12.

Chairman Elihu Thomson, of the committee of organization, called the meeting to order at 10 o'clock, and said:

"It is a great pleasure, gentlemen, that we have with us to-day the president of the Exposition, Mr. David R. Francis, whom I have the pleasure of introducing to you."

Mr. Francis in his address made this reference to electricity:

"We might call electricity the new science. The discoveries that are being made in it from day to day will no doubt necessitate another classification or subclassification before another Exposition is held, whether that Exposition will be universal or an international exposition of electricity.

"The wisdom that has been exercised by the organizers of this Congress, and by those who have kept it in existence from year to year, indicates a great breadth of view, and a remarkable foresight in regard to the development of electricity. The different branches of this Congress all demonstrate how far-reaching are the discoveries in electricity."

Chairman Thomson—We will now proceed to open the Congress, and it is perhaps well at this time, to recall a little of our past history. The four hundredth anniversary of the discovery of America was celebrated in 1893 by the establishment of a great Exposition. The Chicago International Electrical Congress, the work of which is doubtless familiar to many of those present to-day, was the first great gathering of electrical students and workers held in the Western Hemisphere. A little over 100 years ago the then youthful but ambitious republic of the United States of America, acquired from France, by the expenditure of $15,000,000 purchase money, the possession of an enormous territory extending from the shores of the Gulf of Mexico, west of the Mississippi River, northward and westward to the Pacific Coast. The northern limit was undefined, and was settled long after by treaty with Great Britain. The tract includes every variety of farm land, forest, semi-arid and arid land. Much of the arid land is amenable to irrigation. The agricultural and mineral wealth is beyond estimation. The Louisiana Purchase must be regarded as an event not less important

than any other in the history of this great nation, fitly to be celebrated after 100 years by a great Exposition, showing the results of human activity and progress in the arts, sciences and engineering—and might I add, especially in electrical science and engineering—the first in the new century just begun. It was natural that an International Electrical Congress should have been deemed desirable. Accordingly, a committee of organization was called together by the Exposition authorities. The committee on undertaking the work realized that the task was not a light one, and invoked the aid of the American Institute of Electrical Engineers and the other societies which have affiliated themselves with the Congress.

Col. Samuel Reber—Mr. President, I move that the president appoint a committee of three to report to the Congress officers for permanent organization. (Motion seconded and carried.)

Chairman Thomson—I will appoint as such committee Col. Reber, chairman; Prof. Perry and Prof. Lombardi, and request that the committee will immediately begin its deliberations on this very important subject.

Prof. H. S. Carhart—Mr. President, I move that a committee of three be appointed by the chair to nominate honorary officers of this convention. (Motion seconded and carried.)

Chairman Thomson—I have pleasure in appointing Prof. Carhart, chairman; and Mr. W. D. Weaver and Mr. Carl Hering, as the committee to nominate honorary officers of the Congress.

I now have the pleasure of calling upon Mr. R. Kaye Gray, president of the Institution of Electrical Engineers of Great Britain.

Chairman Thomson then introduced Mr. R. Kaye Gray, president of the Institution of Electrical Engineers of Great Britain, who made a brief address, and he was followed by Prof. Ascoli, of the Associazione Elettrotecnica Italiana, and M. Guillebet de Norville, who represented the Republic of France. The foreign speakers were enthusiastically applauded. Prof. Goldsborough was the next speaker, and after briefly reviewing the electrical work of the Exposition, extended a cordial welcome to the delegates on the part of the electrical men of St. Louis.

Chairman Thomson—We are now ready for the report of the nominating committee.

Col. Reber—I am instructed by my colleagues on the committee to report the following officers for the permanent organization:

President, Elihu Thomson; Secretary, Dr. A. E. Kennelly; Treasurer, W. D. Weaver; Vice-Presidents, Bion J. Arnold, Prof. H. S. Carhart, Prof. W. E. Goldsborough and Prof. S. W. Stratton,

For officers of the sections, the following:

Section A—Chairman, Prof. Edward L. Nichols; Secretary, Prof. Howard T. Barnes. Section B—Chairman, Prof. Charles Proteus Steinmetz; Secretary, Prof. Samuel Sheldon; Section C—Chairman, Prof. Henry S. Carhart; Secretary, Mr. Carl Hering. Section D—Chairman, Mr. Charles F. Scott; Secretary, Dr. Louis Bell. Section E—Chairman, John W. Lieb, Jr.; Secretary, Mr. Gano S. Dunn. Section F—Chairman, Dr. Louis Duncan; Secretary, Mr. A. H. Armstrong. Section G—Chairman, Mr. Francis W. Jones; Secretary, Mr. Bancroft Gherardi. Section H—Chairman, Dr. William J. Morton, Secretary, Mr. William J. Jenks.

The officers were elected by acclamation.

The committee on the election of honary vice-presidents and honorary chairmen of the sections made its report, and the members (nearly all the leading foreign delegates) were elected by acclamation, after which the Congress adjourned.

Second Day's Session.

The second day's session of the Congress was executive. There were short discussions over the proposed changes in the international measurement standards. A decision was reached to appoint two committees, one to deal with the fundamental unit question and the other to take up the practical standardization of sizes in electrical machinery, with a view to establishing an international agreement. The issue over the measurement units is between the American members on one side and the European scientists on the other. The United States Bureau of Standards has fixed and legalized material standards for the ohm and volt. The English electricians adhere to the absolute mathematical units, leaving the material unit open to change. Several members were of the opinion that the chamber would not reach any decision on the unit standard, leaving this open for further developments in electrical research.

Third day's Session.

The registration at the Congress increased to over 500 Tuesday. The section meetings were well attended. Wednesday there were no section meetings. These were waved so that the members could attend the joint meeting of the American Institute and the British Institution in Festival Hall at the World's Fair. The programme for this meeting was a general discussion on the application of the alternating current to traction.

Fourth Day's Session.

The sections resumed their meetings Thursday morning. A feature of the programme was a paper by F. B. Behr of London on "The Monorail." Mr. Behr, who is a noted English inventor, described the new system by which it is proposed to run cars at a speed of over 100 miles an hour. A working model of the system is now on exhibit in the British section of the Palace of Electricity, showing the line between Manchester and Liverpool. It is Mr. Behr's intention to build and equip a road on the same principle in this country. He says the distance between St. Louis and Chicago could be covered in three hours by this means.

Fifth Day's Session.

The chamber or delegates of the International Electrical Congress engaged in a long discussion over a resolution for the creation of a commission to fix an international standard of electrical measurement. While the main issue on the volt unit was over the use of the Weston or the Clark cell, this was not mentioned in the resolution. The action of the chamber in agreeing to a commission amounts to a compromise between the divergent views of the American and English delegations on the unit problem. The Americans are for the adoption of the Weston cell as the unit for measuring the volt, because it is a nearer approach to absolute accuracy than the Clark cell. The difference between the two is calculated at 1-1000th part of the unit. While accepting the shade of improvement in the Weston cell over the Clark, the English electricians said they were in favor of leaving the standards as at present for later developments in electrical research.

Prof. E. Rutherford of McGill University at Montreal, the noted experimenter and authority on radium and radio-activity of metals, delivered a lecture on radium before the meeting of Section A. Commenting on the claims of a coterie of French scientists to discovering a new ray called the N-ray, possessing remarkable properties, Prof. Rutherford said that the originators had failed utterly to prove that they had found any sort of a ray. The whole business, he said, was all "bosh." The composition supposed to emanate the N-rays was placed under a

box side by side with another similar box and the scientists were unable to tell which was giving off the supposed rays.

The great cosmical physicist and mathematician, Dr. Svante Arrhenius, of the University of Upsala, Sweden, read a most remarkable paper, record-breaking, universal and far-reaching in its importance. A mere outline only can be given here:

"Ever since Newton discovered the law of gravitation it has been thought all matter is under its control. So it is, but in some cases it is balanced, and in others overcome. There is repulsion, also; and repulsion in the sun leads to consequences of universal import.

"The potentiality of the matter has been known for several years; that is, its kinetic energy, or energy of motion. This has been employed by the most eminent mathematicians in computing the total quantity of heat that could be evolved by condensation to a solid of all the matter known to exist in the sun, even if it had once been a very rare gas, with any assigned diameter.

"The quantity of heat is known and its rate of emission now is known, and it has been found that if our sun now shrinks in diameter 9 inches per day, the friction will supply heat enough to maintain its present rate. This implies, however, that the heat will come to an end, and that the solar globe will expire and with it all life in the solar systems.

"A particle near the sun can have a diameter that is a cross section, so that light and every form of radiation from the sun will strike it and balance gravity. It will float in the atmosphere of the sun without weight, but if the diameter of the particle is smaller that the critical dimension, which is also known, the minute particle will fly away from the sun in 75 minutes and to the earth's distance in 68 hours.

"But it will fly back, come into the sphere of activity or other suns and fall therein, keeping up their heat; and our sun receives from all the others also. The inevitable conclusion is that the heat of our own and the other quadrillion of suns is perpetual. So the universe is shown scientifically to be without beginning or end.

"In view of these stupendous deductions our conceptions of duration are enlarged. The world's beginning or end, however, might as well be out of the dictionary, for the mind of man in its present condition cannot comprehend either."

The discovery of Arrhenius, it is claimed, ranks with any ever made by man.

The American Institute Meeting.

With several hundred of the members of the International Association of Electrical Engineers present, the American Institute of Electrical Engineers opened its convention in St. Louis on September 14.

The meeting was devoted to the president's annual address and to a joint discussion upon the subject of "Different Methods and Systems of Using the Alternating Current in Electric Motors." Mr. Bion J. Arnold of Chicago, president of the American Institute; Mr. Lamme of Pittsburg and Dr. Steinmetz of Schenectady took part in the discussion.

President Arnold spoke in glowing terms of the possibility in the near future of the electric motor invading the field now occupied by the steam locomotive. "The main objection to a more extended use of electric power in heavy hauling," he said, "is the fact that the traffic is not great enough to warrant the running of trains at short intervals, and the electric system can be economical only when operated in this way." Mr. Arnold referred to the use of electric motors on the terminal railroads of New York as an effective illustration of the comparative benefits of steam and electricity.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPT. 13, 1904.

Electric Railways and Appliances.

769,813. System of Signaling on Railways. Francois Bongrand, Cusset, France. Filed Aug. 7, 1900.

769,854. Trolley-Wheel. William P. Wilkinson, Medford, Mass. Filed Dec. 18, 1903.

769,862. Guard for Third Rails. John H. Guest, Brooklyn, N. Y. Filed Dec. 12, 1903.

769,900. Switch-operating Device for Street Railways. Henry S. Hale, Philadelphia, Pa. Filed Jan. 5, 1903.

769,920. Dynamo-Mounting for Railway-Car Trucks. Willard F. Richards, Buffalo, N. Y., assignor to Charles M. Gould, New York City. Filed Nov. 2, 1903.

770,041. Electric Railway. Asa F. Batchelder, Schenectady, N. Y., assignor to the General Electric Company. Filed March 29, 1901.

Electric Lights and Appliances.

769,739. Electric-Lighting Device. Otto Gergacsevics, Vienna, Austria-Hungary. Filed Nov. 30, 1903.

769,842. Electric-Arc Lamp. Frederik Sindingchristensen, New York City. Filed Sept. 29, 1903.

769,996. Electric-Arc Lamp. Richard Fleming, Lynn, Mass., assignor to the General Electric Company. Filed Feb. 20, 1903.

770,222. Manufacture of Electric Incandescent Lamps. Francis M. F. Cazin, Hoboken, N. J. Original application filed Dec. 16, 1903. Divided and this application filed March 16, 1904.

770,223. Incandescent-Lamp Bulb. Francis M. F. Cazin, Hoboken, N. J. Filed Aug. 17, 1904.

Electrical Machinery and Apparatus.

769,983. Block-Signal System. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 10, 1904.

769,984. Electrical Measuring Instrument. Thomas Duncan, Chicago, Ill. Filed June 26, 1901.

769,986. Electric Meter. Thomas Duncan, Chicago, Ill. Filed July 18, 1901.

769,995. Cut-out or Fuse for Electric Circuits. Otto Feuerlein, Charlottenburg, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Sept. 9, 1899.

770,007. Time-Limit Circuit-Breaker. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 11, 1899.

770,017. Automatic Regulator. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 9, 1903.

770,040. Motor-Control System. Charles E. Barry, Schenectady, N. Y., assignor to the General Electric Company. Filed April 18, 1903.

770,073. Method of Controlling Electric Motors. Chas. W. Kennedy, Rutledge, and Francis A. Pocock, Lansdowne, Pa. Filed April 16, 1902.

770,091. Alternating-Current Machinery. A. S. McAllister, Ithaca, N. Y. Filed Feb. 15, 1904.

770,175. Brush and Brush-Holder for Magneto-Electric Machines. Edward B. Jacobson, Pittsfield, Mass., assignor to the Pittsfield Spark Coil Company. Filed Aug. 20, 1903.

Telephones and Telephone Apparatus.

769,701. Two-Wire Multiple Telephone System. Jacob W. Lattig, West Bethlehem, and Charles L Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, Westchester, Pa. Filed June 6, 1903.

769,702. Telephone Transmitter. Jacob W. Lattig, West Bethlehem, and Charles L. Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, Westchester, Pa. Filed June 6, 1903.

769,760. Telephone Exchange Switchboard Apparatus. Frank R McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Jan. 13, 1902.

769,763. Apparatus for Through Ringing on Telephone Trunk-Lines. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed Dec. 14, 1901.

769,863. Telephone Attachment. William S. Haddock, Uniontown, Pa. Filed Aug. 20, 1903.

770,157. Telephone-Desk Standard. Charles L. Boyce, Detroit, Mich., assignor to the Western Electric Company. Filed Aug. 9, 1902.

Miscellaneous.

769,398. Electric Switch. James C. Keller and Otto F. Kadow, Cleveland, O. Filed June 10, 1903.

769,738. Lightning-Arrester. Willis H. Geist and John E. Geist, Gallatin, Mo. Filed April 26, 1904.

769,812. System of Multiple-Electric Motor Control. William Baxter, Jr., Jersey City, N. J. Filed Aug. 29, 1903.

769,815. Dynamo. Martin C. Burt, Chicago, Ill. Filed Nov. 14, 1903.

769,824. Electric Fire-Alarm. William B. Hopkinson, Muscatine, Ia., assignor of one-half to Amos Coe Hopkinson, same place. Filed April 16, 1904.

769,973. Means for Protection Against Reversal of Energy. Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Nov. 2, 1903.

769,975. Storage Battery. James P. Wood, Buffalo, N. Y. Filed March 14, 1904.

770,033. Electrolytic Meter. Howard I. Wood, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 14, 1903.

770,034. Fuse. Gilbert Wright, Pittsfield, Mass. assignor to the Stanley Electric Manufacturing Company. Filed Sept. 28, 1903.

770,054. Electrical Connector. Philip H. Fielding, New York City. Filed July 31, 1903.

770,098. Dynamo-Regulator. George S. Neeley, St. Louis, Mo. Filed Jan. 19, 1904.

770,099. Voltage-Regulator for Dynamos. George S. Neeley, St. Louis, Mo. Filed April 1, 1904.

770,109. Vapor Electric Apparatus. Max von Recklinghausen, New York City, assignor to the Cooper Hewitt Electric Company. Filed Oct. 17, 1903.

770,125. Device for Turning Electric-Car Signs. Joseph M. Smith, Worcester, Mass., assignor of one-half to George L. Church, same place. Filed Jan. 25, 1904.

770,140. Electrode for Batteries. Albert C. Wood and James A. McMullan, Philadelphia, Pa. Filed April 22, 1902.

770,197. Gas or Vapor Electric Device. Percy H. Thomas, Pittsburg, Pa., assignor to the Cooper-Hewitt Electric Company. Filed May 2, 1903.

770,229. Wireless Signaling Apparatus. Lee de Forest, New York City, assignor to the Greater New York Security Company. Original application filed May 14, 1902. Divided and this application filed March 14, 1903.

770,230. Electrical Indicator. William J. Forrest, Jr., Kenosha, Wis. Filed Nov. 30, 1903.

770,233. Gas or Vapor Electric Apparatus. Peter C. Hewitt, New York City, assignor to the Cooper Hewitt Electric Company. Original application filed Feb. 12, 1902. Divided and this application filed June 10, 1903.

THE TELEPHONE WORLD.

Pennsylvania Independents to Meet.

A call has been sent out to the Independent telephone companies of Pennsylvania to meet at Harrisburg September 27 and 28 to form a State Association.

Fifteen companies signed the call, including the Keystone Company of Philadelphia.

Those present at the meeting when the call was decided upon were W. B. Tresk, E. D. Schade William Spencer, J. G. Splane, R. E. Umbel, Samuel E. Wayland, George B. Rudy, D. F. La Fene, W. D. Barnard, H. E. Bradley, B. F. Meyers and William Flynn.

There are said to be 100,000 Independent telephones in Pennsylvania, and 5,000 miles of trunk lines, representing $50,000,000 to $75,000,000 capital Four or five other States have organizations.

Large possibities of consolidation loom up in the future. For the present nothing but association is contemplated.

Southern Indiana Independents to Hold a Convention.

The annual meeting of the Independent Telephone Association of Southern Indiana will be held at Rockport, Ind., September 26 and 27. The present officers of this association are: C. D. Knoefel, president, New Albany; L. G. Davis, vice-president, Salem; E. W. Pickhardt, secretary, Huntingburg; T. M. Thom, tréasurer, Lamar.

The Akron People's Telephone Company will in the near future construct a line through many of the rural districts surrounding Barberton, O., which have heretofore been without the advantages to be derived from the telephone. The company has a man at work on the rural mail delivery routes out of Barberton, covering the road and ascertaining whether or not it would be a paying proposition to construct the lines. From the present outlook it will be a certainty and will be in operation before winter sets in.

A county telephone line has been organized at Romulus, N. Y., to be called the McDougal Telephone Company. At a meeting of the stockholders, Addison Baldridge was elected president; R. C. Allen, vi e-president; Clarence C. Updike, secretary, and Alexander Baldridge, treasurer. Work is to be begun at once, and it is expected the new line will be in operation before winter.

W.A. Strickland, of Turner, Kan., who now operates an Independent telephone system along the Kaw Valley, which is patronized by 100 farmers living between Turner and Argentine, will ask the council of the latter city at its next meeting to grant him a franchise to extend the system into Argentine.

At the last general assembly of Illinois a law was passed placing the property of telephone companies, especially the lines and poles, under the class of real instead of personal property. Under the former law telephone property, being considered as personal, could not be mortgaged.

A strong rate war is on between the two telephone companies at Pottsville, Pa. The Bell Telephone Company has announced a reduction to $12 per year for family telephone service.

The Interstate Independent Convention.

The annual convention of the Interstate Independent Telephone Association will be held in Chicago, December 13, 14 and 15.

The special committees appointed at the last convention, and empowered to act on questions of vital importance, have worked diligently throughout the year, and their reports at the next convention will be very conclusive, and will show that a great deal of work has been accomplished for the Independent movement.

The present officers are: Henry A. Barnhart, president, Rochester, Ind.; E. H. Morton, vice-president, Minneapolis, Minn.; E. M. Coleman, secretary, Louisville, Ky.; E. B. Conklin, treasurer, Aurora, Ill.

The Meadville Telephone Company has closed a contract to build a line between Meadville and Cochranton, Pa. When this line is completed it will give the Meadville company a through copper circuit to Pittsburg, and will also give them direct connection with Franklin, Oil City end Titusville. The contract calls for the completion of the line in 60 days. Every attention will be paid to the work of construction, and the new line will be first-class in every respect.

The Virginia State corporation commission has granted a charter to the Toluca & Fredericksburg Telephone Company for the building of a 'phone line from Fredericksburg, Va., to Toluca, in Stafford County, by way of Boscobel, Brook, Stafford Court House and Garrisonville. The contract for the building of the line will be let at once, and it is expected that it will be in serrvice in a few weeks.

In the Superior Court of Pennsylvania, it has been decided that if the employes of a company mutilate trees on private property, the company may be held responsible and that wires placed on houses without permission may be removed by the owner.

The city council of Fremont, Neb., has granted the application of the Fremont Telephone Company, the Independent company, for a new license, and the difficulties between that company and the city, which have been in the courts for seven months, are apparently at an end.

The New York Telephone Company has been ordered, in a peremptory writ of mandamus by Justice White, of the Supreme Court, Brooklyn, to restore its service to the New York & New Jersey Distributing & Circulating Company.

All the property of the Jacksonville, Fla., Telephone Company was sold recently, and was bought in for the sum of $5,000 by D. C. Gerow, who is supposed to represent the principal creditor, he being the only bidder.

The justice courts of Chicago have rendered many judgments against the Chicago Telephone Company for nickels dropped in public stations in cases where connections with parties called are not secured.

The Cumberland Telephone Company has bought out all the local companies of Chickasaw County, Miss.

Mutual Telephone Company Plans Long Toll Line.

The Mutual Telephone Company of Des Moines, Ia., is negotiating with the Independent long-distance telephone company, which now has connections between Kansas City and Philadelphia and within a very short time will have reached every center of importance from New York to Denver, and eventually will enter San Francisco.

It is understood that the proposition contemplates the construction of a long-distance circuit between Des Moines and St. Louis. The idea is that the long-distance line will build half of this construction if the Des Moines concern builds the rest. The construction must be original, but the poles of Independent companies already in existence may be used. No. 8 wire must be used, however, and the wire which the companies use for local business will not accommodate the long-distance service, if the best is desired--such service, for instance, as calling up St. Louis from Des Moines direct without any transfers or other connections. This sort of service is now maintained by the long-distance company between Kansas City and St. Louis, and between St. Louis and Eastern cities.

The Independent long-distance lines now reach from St. Louis to almost every point of importance in the East, including Baltimore, Pittsburg, Philadelphia, Cleveland, Cincinnati, Chicago, etc. The company which is back of the project has millions at its command.

The Mahanoy & Mahantongo Telephone Company, a concern that will do business throughout the farming regions of Northumberland, Dauphin and Snyder Counties, Pennsylvania, will be organized in the near future. The central exchange will be located in Herndon.

The Badger Telephone & Telegraph Company will have a toll line in operation between Racine, Wis., and the Mississippi River by November 1. The right-of-way has been secured.

The Morrill Rural Telephone Company of Morrill, Morrison County, Minn., has filed articles of incorporation with $50,000 capital stock.

Telephone Incorporations

The Star Line Telephone Company, Chicago, Ill. Capital stock, $100,000 Incorporators: H. H. Knippe, J. S. Abbot and A. L. Maxwell.

The Allegheny Valley Telephone Company, Coudersport, Pa. Capital stock, $5,000. Treasurer, A. C. Boerner, Coudersport. Directors. A. C. Boerner, F. A. Stebbins, Fred C. Leonard, C. A. Stebbins, A. E. Woods, Coudersport.

The Home Telephone Company, Washington, D. C. Capital stock, $300,000. Incorporators: George H. Corey, Eugene Schooley and J. L. Cohencious.

The Union Telephone Company, Erie, Pa. Capital stock, $10,000. Treasurer, W. B. Barnard. Directors: Wm. B. Trask, W. H. Wilson, James Russell, Erie; W. B. Barnard, Philadelphia, Ellis L. Orvis, Bellefonte,

The Century Telephone Construction Company, Buffalo, N. Y. Capital stock, $500,000 Directors: B. G. Hubel, Martin Coney and Theodore S. Fassett, Buffalo.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Baxter, Ia.—The special election held recently to vote on the issuance of $4,500 bonds for a lighting plant was carried.

Brighton, Ala.—This city contemplates establishing an electric light plant.

Clinton, Ia.—O. K. Cole, of Cincinnati, has purchased the controlling stock in the electric lighting plant here, and will assume immediate charge. He is making extensive improvements.

Clinton, S. C.—The proposition to issue $25,000 bonds for the purpose of putting in waterworks and an electric light plant was carried.

Dayton, Tenn.—The new electric light plant was recently destroyed by fire.

Dyer, Tenn.—The electric light plant here was lately destroyed by fire.

East Palestine, O.—The council has decided to issue $9,000 bonds for the improvement of the local lighting plant.

Grand Haven, Mich.—This city will spend several thousand dollars on improving the municipal electric light plant.

Grass Lake, Mich.—This town is agitating for electric lighting.

Lexington, Ky.—An ordinance has been passed for the locating of several new arc lights in the streets here.

Manitowoc, Wis.—The issue of bonds for the municipal ownership of a lighting and sewerage system was carried at the special election recently held in the village of Kiel, Wis.

Moscow, Idaho.—The Moscow Electric Light Company has submitted a proposition to the city council to run the city waterworks pumps by electrical power. Included in the proposition is the furnishing of arc lights to the city for five years, at the rate of $8 per lamp per month.

Mount Healthy, O.—A special election will be held October 8 to vote upon the question of issuing $28,000 bonds for an electric light and waterworks plant.

New Hampton, Ia.—The town of Waverly is up against the lighting proposition. A committee of the council made a report that the town is inadequately lighted, but the private company wants $20,000 for its plant. An election has been called for September 26 to decide as to city ownership.

New York City.—The rumor is current again that Philadelphia interests have secured control of the United States Light & Heating Company. This company was organized in 1892 for electric lighting railway trains, and has equipped the Empire State Express cars with its electric lighting system, also the dining cars of the Lackawanna.

Owensboro, Ky.—The foundation for the addition to the electric light plant here, has been laid.

Roswell, N. M.—E. H. Fisher, of Alamagordo, was in Artesia, N. M., recently, investigating the field with a view to installing an electric lighting system there.

Southampton, N. Y.—A meeting of the stockholders of the Southampton Electric Light Company was held recently at the office of Harry M. Howell, to take action in regard to selling the plant to the Suffolk Light, Heat & Power Company. Authority was given to the directors to accept the offer which has been made.

Springfield, Tenn.—Work will commence in a few days on the electric light plant and waterworks system here.

St. Joseph, Mo.—Bonds to the amount of $325,000 has been issued by the city, $250,000 of which is to be spent in the construction of a sewerage system, and the balance in the construction of an electric lighting plant.

Sumner, Ia.—The town of Sumner had a city election to decide whether the town should remain in perpetual darkness or have an electric light plant. The light plant people carried the town by a vote of 204 to 24.

Wallace, Idaho.—The town of Gem, Idaho, was recently damaged by fire to the amount of $125,000. The telephone, telegraph, electric light and the lines of the Washington Water Power Company were destroyed.

Wayne, Neb.—This city is to be lighted by electricity. L. W. Roe, chairman of the city lighting company, is advertising for bids for the installation of a power plant and equipment.

STREET RAILWAYS.

Albany, N. Y.—The Auburn & Northern Electric Railroad Company, capital $250,000, has been incorporated here.

Austin, Tex.—Ex-Governor W T. Thornton, of New Mexico, with Chicago capitalists, projects building an electric street railway system in Guadalajara, Mexico. Governor Thornton has made an offer of $400,000 for the franchise.

East Palestine, O.—An entirely new trolley line is projected for this section of Ohio, and Engineer S. M. Dick is making surveys for it.

East Orange, N. J.—The proposed street car line is soon to be built here on Central avenue.

Hannibal Mo.—J. E. Carter, W. Osgood Orton and others here are interested in the proposed electric line between this city and Quincy.

Kewanee, Ill.—The Galesburg & Kewanee Electric Railway Company has made application for a 50-year franchise.

Knoxville, Tenn.—The Knoxville Traction Company is busy surveying its new line.

Louisville, Ky.—The property of the Highland Electric Railway Company of New Albany has passed into possession of the Louisville & Southern Indiana Traction Company. The deal has been on for several months and was finally completed at a meeting of representatives of the two companies held in New Albany.

McKeesport, Pa.—The Pittsburg & Westmoreland Street Railway Company has asked rights-of-way for a new road that is to be constructed between points in Westmoreland and this city.

Milford, O.—The Cincinnati & Columbus Traction Company has been granted a new franchise by the council of this village.

Newark, N. Y.—The village trustees have granted a franchise to the Rochester, Syracuse & Eastern Electric Railroad Company to operate cars through the streets of Newark. The franchise is not exclusive, but any other railroad to which the village authorities may give a franchise may operate its cars on the same streets by payment of proper compensation.

New Albany, Ind.—The Louisville & Southern Indiana Traction Company proposes to build a line from here to Corydon.

New York City.—The newly incorporated South Shore Traction Company has been granted permission to construct a 60-mile trolley road through Suffolk and Norfolk Counties, L. I.

North Milwaukee, Wis.—The Illinois Traction Company is constructing an electric line from Springfield to St. Louis.

Pittsburg, Pa.—Two big electric railway projects, backed mainly by Pittsburg capitalists, are to be launched in the near future. One will be known as the Pittsburg & Allegheny Valley Railway. with a capital stock and bond issue amounting to $1,100,000, and the other line will be called the Meyersdale & Salisbury Railway and will have a capital of $1,500,000. O. W. Kennedy, formerly manager of the H. C. Frick Coal Company, is to be president of both lines.

Rahway, N. J.—A proposed new trolley line is looking for the right of way through from this city, to partially parallel the Public Service lines and provide a shorter line between New York and Phildelphia.

Sioux City, Ia.—The city council has granted a franchise to a Des Moines syndicate for the construction and operation of an electric street railway system in this city. The syndicate is composed of S. C. Lee, A. H. Marshall and others.

Tacoma, Wash.—The street car facilities and manufacturing plants supplied by electric power were badly crippled recently by forest fires.

Trenton, N. J.—Judge Lanning, in the United States Circuit Court, made an order authorizing Receiver James Smith, Jr., to lease the Atlantic Coast Electric Railroad Company to the Seacoast Electric Railroad Line. The latter company's line connects at Belmar, N. J., with the Atlantic Coast Line.

POWER PLANTS.

Albany, N. Y.—For August the Hudson River Water Power Company earned $54,472 gross—the largest month's earnings yet reported These earnings were secured from five generators. A sixth generator is now being installed and the ultimate development will be 10 generators.

Chicago, Ill.—The National Provision Company is to build a new plant at Butler and 39th streets. A 2-story power plant is among the buildings planned.

Philadelphia, Pa.—Cramp & Co. are estimating for a power house for the Philadelphia & West Chester Traction Company at Ridley Park.

BIDS WANTED.

Fargo, N. D.—The city auditor was instructed to advertise for bids for the lighting of the city for the coming year.

Washington, D. C.—Sealed proposals in triplicate will be received until October 8 for the construction, plumbing and electric wiring of non commissioned officers' quarters at Post Barancas, Fla. The Government reserves the right to accept or reject any or all proposals. Address W. E. Cole, Quartermaster.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12⅝@12¾c.; casting, 12⅜@12½c.

The Washington Water Power Company of Spokane has declared the usual quarterly dividend of 1½ per cent., payable October 1.

The Twin City Rapid Transit Company has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable October 1.

The National Battery Company of New York City has filed with the Secretary of State at Albany a certificate of increase of capital from $500,000 to $1,000,000.

The Detroit United Railway Company has declared the regular quarterly dividend of 1 per cent., payable November 1. Books close October 15 and reopen November 2.

The Western Union Telegraph Company has declared the regular quarterly dividend of 1¼ per cent., payable October 15. Books close September 20 and reopen October 14.

Stone & Webster report that a dividend of $3 per share has been declared, payable October 1, on the preferred stock of the Seattle Electric Company to stockholders of record at the close of business September 22.

Judge Grosscup of Chicago is reported to have brought two experts from Boston who are making a thorough and secret investigation of all the books, financial condition and property of the Chicago Union Traction Company and its underlying companies.

The Massachusetts Board of Railroad Commissioners has authorized the Pittsfield Street Railroad Company to issue 1,000 additional shares of capital stock at $110 per share, to pay off the floating debt incurred by extensions and to pay for further extensions.

A meeting of the stockholders of the St. Louis Transit Company has been called for October 19 to ratify a proposition to cancel the issue of $20,000,000 improvement and refunding bonds authorized last May and to issue in lieu thereof bonds not exceeding $12,500,000.

The directors of the Louisville (Ky.) Traction Company have fixed the rate of the annual dividend on the common stock at 2½ per cent. Many of the stockholders had expected that the rate would be 3 per cent.. The dividend, as fixed, will be paid semi-annually.

The Lansing (Mich.) City Electric Railway and the Lansing, St. Johns & St. Louis Railway Companies have been merged. The new company, which is known as the Lansing & Suburban Traction Company, has authorized a bond issue of $750,000 to take up the bonds of the underlying companies and to provide for further extensions.

There has been some switching from Metropolitan Securities to Metropolitan Railway of New York. The buyers of the latter say the dividend is sure enough so long as the Metropolitan Securities' liability to assessment continues; and by the time that it is exhausted something may happen to change the traction situation.

The fiscal year of the Massachusetts Electric Companies ends September 30. While the directors do not take action upon the preferred stock dividend until late in the year, the dividend being payable January 1, sufficient is known as to the year's earnings to warrant the belief that it will be inadvisable to pay the next semi-annual dividend of 2 per cent. This dividend is cumulative, however, and, if passed, will undoubtedly be paid at a later date.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Noon price Sept. 19
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	154¼
Metropolitan Street Railway	121
Metropolitan Securities	80¼
Ninth Avenue	197
Third Avenue	123¼
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	55½
Public Service Corporation (New Jersey)	98
Philadelphia.	
Consolidated Traction of New Jersey	71½
Philadelphia Traction	97¾
Union Traction	56½
Boston.	
Boston Elevated	154⅛
Massachusetts Electric Companies, com	12¾
do. do. do. pref.	60
West End Street, com	91⅞
do. do. do. pref.	111¼
Chicago.	
City Railway	188
North Chicago	71
Union Traction, com	7½
do. do. pref.	37

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Noon price Sept. 19
New York City.	
Allis-Chalmers, com	11½
do. pref.	50
Electric Boat, com	40
do. do. pref.	74
Electric Lead Reduction	¾
Electric Vehicle, com	16
do. do. pref.	20½
Westinghouse, com	163
do. pref.	180
General Electric	171
Boston.	
Edison Electric Illuminating	260
General Electric	171½
Westinghouse Electric & Mfg., com	80
do. do. do. pref.	90
Chicago.	
Chicago Edison	150
National Carbon, com	35¼
do. do. pref.	109
Philadelphia.	
Electric Company of America	9⅝
Electric Storage Battery, com	66
do. do. do. pref.	66

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Noon price Sept. 19
Boston.	
American Telephone & Telegraph Company	139
Western Telephone Company	14
New England Telephone Company	123¾
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	210
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	91⅞
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..

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Name.	Noon price Sept. 19
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Consolidated Car Heating	64
Standard Underground Cable	200

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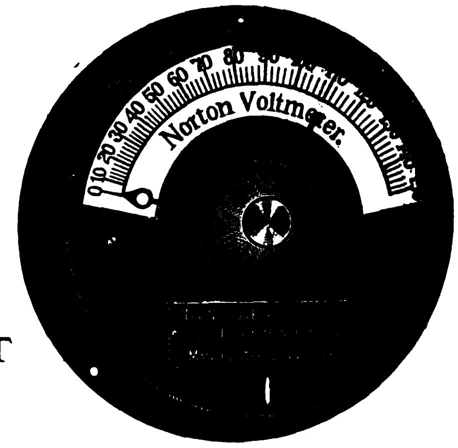

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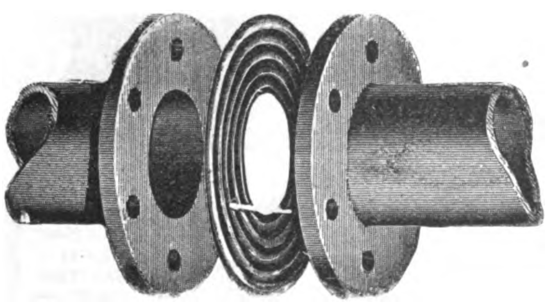

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THE AULTMAN COMPANY, CANTON, O.

ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

A Reason For the Vagaries of Lightning.

It is strange to speak of conductors that will not conduct, and it is equally strange to speak of non-conductors that will conduct. Yet this is the situation confronting us when we examine into the apparent idiosyncrasies of lightning—its peculiar choice of paths, its leaps from conductors into the air, and from the air back again to conductors. Some light can be thrown on the mass of evidence indicating the erraticism of lightning discharges, by reference to one or two purely scientific and mathematical propositions entitled "The Alternative Path," and "Electrical Oscillations." Digressing for a moment, it is rather startling to realize that in all probability the electricity of the earth is as much responsible for deaths and the destruction of property as the enormous discharges apparently emanating from the lowering clouds above. The so-called disruptive discharge, due to an accumulation of potential at two points, whose limited capacity has led to this condensation of electricity and the consequent discharge when the difference of potential becomes too great for the intervening space to resist its flashing leap—is familiar to all. It has been duplicated on a smaller scale in every laboratory of physics in the civilized world. Other important and interesting facts have been deduced, which find their place under the titles given above. First, What are electrical oscillations? To be explicit, it may be stated that all static discharges, great or small, and this of course includes lightning, can become oscillatory in character. By the term oscillatory, is meant a series of back and forth surges of electricity frequently, of such tremendous rapidity that they may reach the rate of 30, 40, 50 or even 100,000,000 oscillations per second. While reversing, they are constantly diminishing in strength. Second, the oscillations are dampened if they meet with a high resistance, and will increase in frequency, in accordance with a certain law, with mathematical certainty, during the instant of discharge, when the resistance is low. On the other hand, if the resistance is so low, that when the outburst of pressure takes place, the oscillations are so rapid that the conductor will not respond to their influence, all the effects of a tremendous self-induction becomes visible. The charge of electricity finds the low resistance conductor, entirely on account of its own high frequency, practically a non-conductor, and therefore leaps through the air to some conductor of higher resistance, and thus, so to speak, leaping from post to pillar, reaches the earth. This last, the choice of paths, is analyzed under the head of Alternative Paths, and in connection with the theory of oscillations, adequately explains many of the most remarkable peculiarities of lightning in its leaps from the earth to a cloud, or as commonly understood, in its transit from a cloud to earth.

The principle of electrostatic induction explains the electrification of the earth. As for instance, a positively charged cloud hanging overhead, with the earth beneath negatively electrified by induction. If a steeple is in the vicinity armed with a lightning rod, it is quite reasonable to suppose the point of highest potential on that geographical area thus affected to be the rod. The discharge when it takes place, is in all likelihood, just as apt to fly from the rod as from the cloud, and for that reason the possible paradox takes place of the earth sending its lightnings into the sky. A fact, as previously stated, rather startling to the lay mind.

Electricity on Shipboard. Considerable matter has appeared from time to time in these columns on the subject of electrolysis. To prevent stray electric currents from damaging iron and steel structures, has proven one of the most difficult problems that has of late years confronted electrical engineers. The return current of trolley roads, instead of returning to the power house through the rails, frequently finds its way to water or gas pipes with the result that corrosion takes place, followed by leaks. Damage to the extent of thousands of dollars, has been caused in this way, Bridges are frequently in jeopardy from the current of trolley cars passing over them, and it is by no means certain that the anchorage of the Brooklyn Bridge, has not been weakened through this cause. Some time ago it was thought that a United States cruiser lying at the Brooklyn Navy Yard was being damaged through electrolysis, and now advices from Russia state that the Admiralty of that country is worried for fear the metal hulls of some of its warships are being damaged by escaping current, owing to the fact that so much electricity is generated on a modern man-of-war.

With a view to solving the problem the Russian Admiralty has determined that one of seven new torpedo boats now being built for the far East, shall be lighted exclusively by oil, while the others will be lighted by electricity. Thus it is thought an opportunity will be afforded in a practical way to observe the alleged deleterious effect of the existence of electric current on shipboard.

* * *

The Opening of the Subway. It is now stated that the Rapid Transit Subway in this city will be opened without fail on October 27. That is to say, the section that will be opened then extends from City Hall to 155th street and Broadway. The eastern section will not be ready before another two or three weeks. This extends from 104th street and Broadway to 155th street and Lenox avenue. The viaduct section will, so it is asserted, be opened about the same time.

A plan of interest to Bronx residents is being considered in this connection. The Interborough Company is now studying whether it would be feasible to run express trains exclusively over the Second Avenue line during rush hours. Neither the Second nor the Third Avenue line has express tracks over its entire length, and there has been much trouble lately over the express service on the east side.

The plan contemplates an express service from Chatham Square out Second avenue to 149th street, and thence over the subway viaduct system to Bronx Park. It is thought, even, that both the up and down town tracks on the Second Avenue line may be used for this express service in one direction during rush hours. The Third Avenue line would then take all the short-haul traffic.

Elaborate ceremonies will mark the opening on October 27. Speeches will be made by Alexander E. Orr, President of the Rapid Transit Commission, by Mayor McClellan, August Belmont and others. There will be music and feasting, and when it is over the patiently-waited-for, and much needed rapid transit system, will be a reality.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The Kosaka mines, one of the most extensive copper properties of Japan, are to be equipped with considerable American hydro-electric machinery.

A station of the American De Forest Wireless Telegraph Company will be established in Syracuse, N. Y., in a few months.

Charles A. Lieb, formerly consulting engineer for the Central Electric Company, and who successfully reorganized and rebuilt the street railways of Washington City, has been nominated by the new interest as mechanical director of the Manhattan Transit Company.

Mr. Ralph D. Mershon has lately been in Niagara Falls, N. Y., conducting a series of interesting experiments on the high voltage transmission of power with a view of utilizing his conclusions in connection with a transmission line between Shawinigan Falls and Montreal.

According to a Baltimore, Md., paper, the Astors are going to build a mono-rail passenger railway line between that city and Washington. The road will cost but $15,000 a mile, and the backers of the enterprise expect trains to run at a speed of 80 miles an hour.

An instrument for directly measuring a magnetic field of approximately uniform amount by means of an exploring coil of known area and number of turns, is described in a recent number of *L'Electricien*. The instrument is due to M. Grassot, and is similar in construction to a d'Arsonval galvanometer, but with a very weak controlling couple, and consequently a very high damping effect.

According to the London *Electrician*, the French Society of Manufacturers is offering a prize of 6,000 francs for the invention of an apparatus for gauging the current of an electrical conductor. Particulars of the competition, which closes on December 31, 1904, can be obtained from M. Le President, Association des Industrials de France, 3, Rue de Lutece, Paris.

A paper on "Electricity and Agriculture" was recently presented by M. Emile Guarini to the Belgian Society of Engineers and Manufacturers, says the *Electrical Engineer*, London. The author considered that the application of electricity in this connection would extend more when electrical energy was produced at coal fields and distributed to farms by wire, but in the meantime electricity can be generated on the farm by water power, steam, gasoline, gas, wind and sun motors. A continuous current is best for farms. The electric motors used ought to be portable, so as to be placed alongside the plough, thresher, straw-cutter, pump, chopper, shearer, churn, etc. The author added that electricity can be used for lighting fields to permit of night work, for heating incubators, for hot air fans, for carbonizing peat into fuel, and other purposes.

An exhibition that will interest every business man in the country will open in Madison Square Garden on December 12 and continue for six days. During that time there will be contests of speed between expert stenographers, and operators of different makes of typewriters will enter into endurance and speed competition for prizes of great value. The exhibition will be the first of the kind ever given in the world, and will include every device for labor-saving in large offices. The floor space for showing goods and for the speed contests has nearly all been taken and it is more than likely that Madison Square Garden will be crowded with persons interested in mercantile affairs, their object being to see if there is not some new article on the market that will save time as well as labor.

Mr. George F. McCulloch has resigned the presidency of the Indiana Union and Indianapolis Northern Traction Companies, but was elected chairman of the Board of each company. Arthur W. Brady, brother-in-law to Mr. McCulloch, succeeds him as president.

THE INDEPENDENT TELEPHONE ASSOCIATION CONVENTION.

There was a large gathering of delegates and visitors at the annual convention of the Independent Telephone Association of the United States, held last week in St. Louis.

Headquarters were at the Inside Inn, situated within the Exposition grounds.

The cartoon in last week's ELECTRICITY was to be seen on all sides, and the general talk among the delegates was that "it sized up the present telephone situation."

The following was the programme for the three days' session:

WEDNESDAY, SEPTEMBER 21.

Reception to delegates, Inside Inn parlor.

Address of welcome, Hon. David R. Francis, president Louisiana Purchase Exposition.

President's annual address, Hon. Hugh Dougherty, president Independent Telephone Association of the United States.

"Electrical Features of the World's Fair," Prof. W. E. Goldsborough, chief department of electricity, Louisiana Purchase Exposition.

"What Telephone Engineering Needs," Prof. J. C. Kelsey, Purdue University, La Fayette, Ind.

"The Value of Organization," James B. Hoge, Cleveland, O.

The call of the States. Informal discussion.

THURSDAY, SEPTEMBER 22.

"The Patent Situation." Edward E. Clement, Washington, D. C.

"Independent Finances," Frederick S. Dickson, president Federal Telephone Company, Cleveland, O.

"Planting a Telephone System," Samuel G. McMeen, consulting telephone engineer, Chicago, Ill.

Address by C. E. Wilson, Keystone Telephone Company, Philadelphia, Pa.

General discussion, "Independent Telephony." This was informal, and nearly all Independents present took part.

FRIDAY, SEPTEMBER 23.

Report of the Secretary-Treasurer, Frank G. Jones, Chicago.

Report of committees.

OFFICERS ELECTED.

President—J. B. Hoge, Ohio.

First Vice-President—R. Jones, Missouri.

Second Vice-President—William Flynn, Pennsylvania.

Treasurer—Hugh Dougherty.

Secretary—A. L. Tetu, Kentucky.

The Regulation of Induction Motors.

In order to reduce the sudden large rush of current on starting up induction motors, says the *Electrical Engineer*, London, Zani-Mailand suggested the winding of the rotor with two independent circuits—one having a high ohmic resistance, but little or no self-induction, and the other having a negligible ohmic resistance, but considerable self-induction. On starting up a motor of this type most of the rotor current will, owing to its high frequency, flow through the path of high resistance and low inductance. An improvement has lately been suggested by Zani, says the *Elektrotechnische Rundschau*, by means of which it is only necessary to have a single rotor winding. Three coils are mounted on iron cores and fixed on the rotor; the ends of these coils are connected in series with the three phases of the rotor winding. In principle these coils act as the primaries of transformers, of which the secondary currents are represented by the eddy currents in the solid iron cores.

Obituary.

PROF. NIELS FINSEN.

A dispatch from Copenhagen, Denmark, dated September 24, states that Prof. Niels Finsen, discoverer of the light cure for lupus and head of the Finsen Ray Institute, is dead. Prof. Finsen, who was a comparatively young man, had been ill for some time past. In December, 1903, he received the Nobel Medical prize from the Norwegian Parliament.

IRA NELSON STANLEY.

Ira Nelson Stanley, who invented one of the fenders now used on the trolley cars operated by the Brooklyn Rapid Transit Company, died suddenly last Wednesday at Freeport, L. I. Mr. Stanley was born in Attleborough, Mass., in 1820.

Street Railway Convention in St. Louis.

The week of October 10 will be Street Railway Week at St. Louis, the Mechanical Association holding its meetings on October 10 and 11, and the Accountants' Association, October 14 and 15. Wednesday, October 12, has been designated as Street Railway Day by the Fair officials, and it is expected to have addresses by President D. R. Francis, Mayor Rolla Wells and Prof. Goldsborough. The manufacturers' committee has prepared a fine programme of entertainment. It will have one of the finest bands in the country, which will give a concert at the hall before the opening of each session, and numerous concerts during the week. On the evening of the 13th the annual banquet of the Association will be held.

Meeting of the Illinois State Electric Association.

The coming annual meeting of the Illinois State Electric Association will be held at Decatur, Ill., on October 5 and 6, with headquarters at the office of the Decatur Railway & Light Company. The business sessions will be held in the Elks' club-rooms in the same building. The programme, it is announced, will be very good On the evening of the 5th seats will be reserved at the opera house for the association. The session on October 6 will be concluded at 1 P. M. At 2 P. M. the guests will take special electric cars, visit the new power house at Riverton and go from there to Springfield. The Hotel St. Nicholas will be the headquarters.

WIRING LEAFLETS.

BY NEWTON HARRISON, E. E.

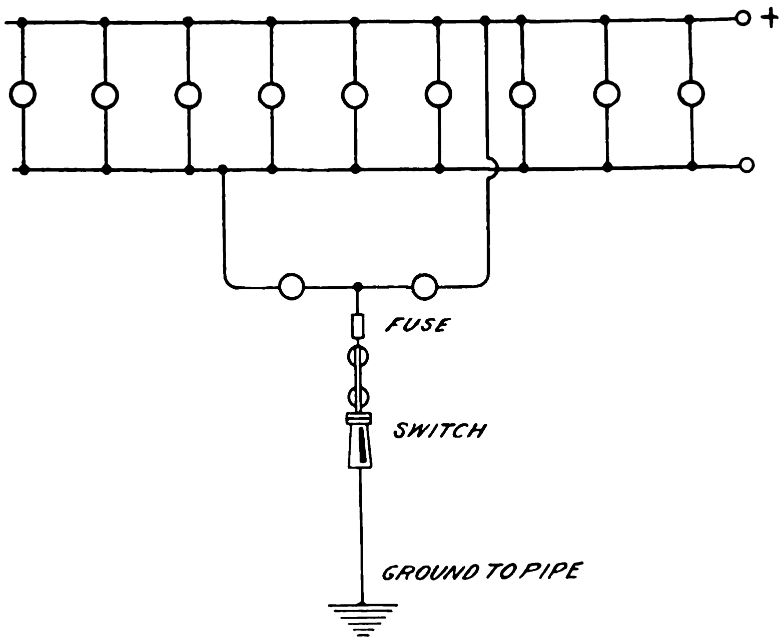
Testing.—Faults develop in electric light circuits and must be discovered and removed. The most flagrant sources of trouble are short circuits and grounds.

Short circuits are caused by the crossing or touching of wires. Grounds caused by wires in contact with gas pipes are what is generally called a good earth connection. Breaks in the wires are evident when the lamps will not burn. Short circuits or crossed wires cause the fuses to blow. Poor connections in the wires occurring where soldering between ends has taken place is due to the resistance of the joint. High resistance frequently is found where wires are held under screws and washers, as in cutouts, switches, sockets, etc.

Operation of the Ground Detector.—For detecting heavy grounds, ground detectors are mounted on the switchboard. The ground detector for a two-wire and three-wire system operate according to the following principle: Two lamps are connected in series across the two main wires. The connecting wire *between* the two lamps is grounded by running a wire from a gas or water pipe and soldering it to this connecting wire. Under ordinary circumstances when both wires are free from grounds the lamps burn with equal brightness. If the ground is on one leg of the circuit the lamp connected to the other leg burns more brightly, and vice versa.

A switch is connected, as well as a safety fuse, between the earth and the

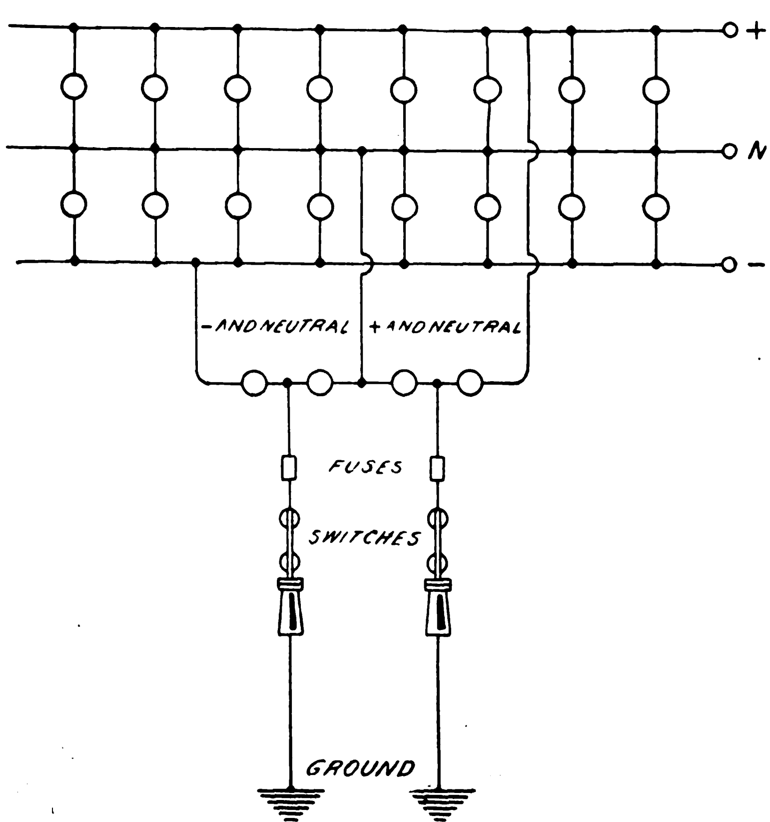
two lamps. This switch is left open except when a test of this character is conducted. The illustration shows the general arrangement of the ground detector for a two-wire system with lamps, switch and fuse mounted.



Ground Detector for Two-Wire System.

In the next sketch is shown the general arrangement of the wires in a ground detector for a three-wire system.

If by any mistake both switches are closed at one time a short circuit will occur, because both of the outer legs are



Ground Detector of a Three-Wire System.

thrown into communication and short circuited by that means. Therefore it is necessary to be careful in testing to open and close *only one* switch at a time and after using it to leave it *open*.

The illustration shows how the fact of a ground occurring on either the neutral or negative wire will make the lamp on either the negative or neutral wire light up brighter than its neighbor. The same is true of the lamps connected to the positive and neutral wires. If a ground occurs on the positive wire the lamp connected to the neutral wire will light up brighter than its neighbor, and the reverse. The danger from grounds arises more from the risk of fire than anything else. If two wires of opposite polarity of the same circuit are grounded the leakage is in proportion to the resistance of each or both grounds.

In street railway practice the danger from grounds is found in the corrosion of pipes through electrolytic action.

Testing with a Voltmeter.—The voltmeter is employed in about the same manner as the lamps. It is connected between the earth and one leg of the circuit. If the other leg is grounded current will flow up into the voltmeter from the earth or from the other wire into the earth. Whichever wire gives a reading indicates that the other wire is grounded. The grounds may be roughly classified as high resistance grounds, low resistance grounds and dead grounds. A high resistance ground runs into thousands of ohms; a low resistance ground into hundreds of ohms and a dead ground means absolute contact between one wire and the earth through a gas or water pipe, etc. If the insulation is high the voltmeter will not read, but if medium or low the reading will be in proportion.

Using the Magneto.—The magneto is more frequently employed for line testing than any other piece of apparatus. One wire from the magneto is connected to a gas or water pipe and the other to each wire of the circuit in turn.

If the magneto rings, a ground is present on the other wire. This method of testing while generally employed is sometimes deceptive, because perfect insulation may provide certain electrostatic conditions which will cause the magneto to receive a return static discharge from the circuit which may cause it to ring. As this is more an exceptional than a common case due consideration may be made for it. Magnetos for testing are so constructed by means of the winding that they will ring through 1,000, 5,000, 10,000, 15,000, 20,000 and 35,000 ohms. They are made to ring through higher resistances than this and are marked according to their capacity in this respect. A ground which can be rung through by a magneto is therefore of the same resistance as the rating of the magneto or less. If an attempt is made to discover a ground in a heavily wound coil, such as the field coil of a dynamo by ringing a magneto through it, the experiment will be unsuccessful, for the reason that the rapid reversal of current from the magneto cannot penetrate the numerous turns of the coil.

This is due to self-induction and will make it appear by the silence of the magneto as though no ground were present.

This fact is of importance in testing any circuits connected to inductive devices for grounds.

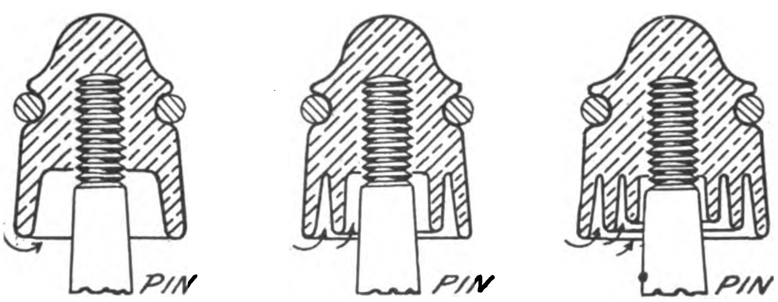
Locating Grounded Circuits.—To locate a grounded circuit each branch must be tested systematically. This is accom-

plished by disconnecting each circuit from its cutout or from the panel board to which it is connected. By testing each one in turn the grounded circuit is sure to be located and then the wires may be examined to discover the cause. Abraded wires are often the cause. Defective insulation on the inside and outside of the conduit is another. Moisture, corrosion and damp walls and plaster are a frequent cause of trouble. Wires touching on the parts of chandeliers and fixtures must be regarded as among the chief causes of trouble and annoyance. The voltmeter is the most scientific and, therefore, the most accurate instrument to use for this purpose. Where the ground is heavy neither the voltmeter or magneto are required. Two lamps in series connected to the circuit in the following manner can be employed: One leg of the circuit is connected to the end wire of the two lamps and the other end to the earth through the medium of a gas or water pipe. This is repeated with the other leg of the circuit. The process is continued throughout every circuit until the fault is discovered.

and fuse blocks must be protected from exposure to dampness by boxing.

Insulators.—The knob porcelain insulators and porcelain cleats in use for electric light wiring must be designed with reference to the mechanical strain to which they will be subjected as well as the insulating properties they are supposed to possess. The glass as well as the porcelain insulators must be designed with reference to strength and insulation. The element of strength is secured by consulting the mechanical requirements in the way of proportioning the diameter, length, diameter of the hole or orifice to receive the wooden peg or screw, etc. The insulating power is obtained through its dependence on the nature of the material, the distance from the wire to the screw or pin and the extent of the hygroscopic power of the glass or porcelain. The materials employed are too well known to require repetition and their hygroscopic power is something unavoidable, but means may be taken to improve the insulating power of the material by the following scheme of construction:

The petticoat, that is to say, the part of the insulator which acts as a hood to the pin, may be doubled or tripled, as shown in the sketches, so as to increase the distance the current must travel from the wire to the pin, through the film of dust or moisture which is bound to collect on its surface according to the weather and age of the insulator. Very often for high potential circuits of over 5,000 volts oil insulators are used. In these, the edge of the insulator is turned up forming a channel in which oil is placed to increase the resistance in the path of an escaping current.



Single Petticoat Insulator. Double Petticoat Insulator. Triple Petticoat Insulator.

The magneto proves exceptionally valuable in locating breaks in a line. This is indicated by the magneto not ringing. Where the continuity of the circuit of a series arc light system is to be tested the two ends of the circuit are connected to the magneto directly and the test made. Poor connections at fuses will cause heating, frequently sufficiently high to melt the fuse. It is therefore best to examine the fuses before exploring the rest of the circuit for breaks. It is good practice to test for grounds every day in order to avoid trouble. In large hotels and apartment houses where the chandeliers and fixtures are continually handled breaks and grounds happen often enough to necessitate this requirement.

Damp Basements.—The grounds in damp places are naturally apt to be frequent, due to obvious causes. It is not always best to install a conduit system in this case, but a knob insulator equipment with rubber-covered wires. Sockets of insulating material must also be employed

Weatherproof Wire.—This wire is used in places such as the name indicates, where the weather can get at it. The wire is made of a certain number of layers of braided cotton-covering soaked in a highly insulating compound. By this means insulation is obtained and protection against wet as well. In large cities where wires are mainly underground, in the form of lead-covered cables, different insulation is employed. But for electric light wires in the country, arc and alternating, and for street railway feeders, this wire is extensively employed.

Cables.—The manufacture of cables is an elaborate process and the coverings of the wires they contain are varied according to the system peculiar to that particular phase of the art. The copper conductors are frequently covered with rubber compound which insulates the wire from the lead sheathing. If the pressure they carry is high the insulation is thicker. It generally varies from about $\frac{1}{8}$ to $\frac{3}{8}$ of an inch. In the case of other cables, the conductor is wrapped around with tough paper soaked in an insulating compound which gives it flexibility as well. A third class of cables for electric light and power might be described as consisting of weatherproof wires incased in lead tubing. The woven covering of the wires in this case consists of a jute or cotton braiding saturated to excess with a black insulating compound which is supposed to resist moisture and not to deteriorate with age. It is imperative to have a lead sheathing so thick that porosity is absent, as that would invite moisture to enter and rapidly destroy the integrity of the cable.

Rotary Converters.—The development of the wiring system of a large central station is in many respects due to the introduction of a variety of new appliances whose use has led to economic changes of immense benefit to the installation as a whole. Among the appliances or devices to be thus considered the rotary convertor possesses a leading interest. It has without doubt caused a change in engineering and station methods of the most far-reaching consequence. A rotary converter is a composite dynamo and motor combined in one machine. If continuous current is sent into it an alternating current can be developed of two or three phase and, conversely, if an alternating two or three-phase current is sent in a direct current will be generated. In other words it is a transforming device which receives an alternating and gives out a direct, or receives a direct and gives out an alternating current. In order to obtain this elasticity of operation a single generator frame is employed within which rotates an armature so wound that it can receive a two or three-phase current at one end or a direct current of from 110 to 550 volts at the other end. The large power stations whose object it is to transmit current for street railway power and lighting purposes can accomplish this object by the use of the rotary converter. In addition, all the generating units, as the phrase goes, can be installed under one

roof and the power from this central station distributed with economy and efficiency from various points at which such power would be useful, called substations. By erecting substations, whose function it is to transform and distribute the power, instead of building power stations a great element of expense is removed and a satisfactory commercial solution is given to the problem of the distribution of power.

Various Equipments.—Many plants have been installed of immense proportions in which these machines for transforming alternating into direct and direct into alternating current has been the means of bringing about investments of millions of capital. The Niagara Falls Power Company now generate and deliver 50,000 hp. to the various factories and work shops, hotels and houses in Niagara Falls and adjacent cities and towns. Over 30,000 hp. is drawn from the main power station and converted into continuous current for operating the street railway lines as well as for light and power in the cities of Buffalo and Lockport.

The leading power stations in Greater New York operate on the same general principle. In these main stations the process of developing the electrical energy is carried on, then the power as a high-tension, alternating current is sent to various substations in which it is transformed into a comparatively low pressure direct current. Among the institutions to which reference is made may be mentioned the power plants and substations of the Manhattan Elevated Railway Company, the Metropolitan Street Railway Company and the Rapid Transit Company whose equipment for the tunnels is one of the greatest as well as one of the most elaborate in the annals of engineering. These developments in electrical engineering are only possible through the recognized efficacy of the "rotaries" as they are called.

Application of Rotaries.—Under the following headings the most important applications of the rotary converter are given as cited by the bulletin of the Westinghouse Company.

I. It may be supplied with alternating current and will deliver continuous current.

II. It may be supplied with continuous current and will deliver alternating current.

III. It may be connected to alternating current mains and operate as a simple synchronous motor.

IV. It may be connected to continuous current mains and operate as a simple continuous current motor.

V. It may be driven by mechanical power as a generator and develop alternating current.

VI. It may be driven by mechanical power as a generator and deliver continuous current.

VII. It may be driven by mechanical power as a generator and deliver both alternating and continuous current at the same time.

VIII. It may be connected to continuous current mains and deliver mechanical power from a pulley on the shaft and at the same time deliver from its collector rings an alternating current.

IX. It may be connected to the alternating current mains and deliver mechanical power from a pulley on the shaft and at the same time deliver from its commutator a continuous current.

Although generally employed for the purpose of transforming the character of the current and the pressure, converters can be operated in multiple or two of them can be connected so as to supply a three-wire system.

Efficiency.—On account of the high efficiency of the rotary converter, as high as that of a dynamo or motor of equal size, the electric light and power problem has been, to a large extent, solved. The regulation and sparking are about the same as would be found in an ordinary generator of equally good design. The Edison Company of New York, whose original plant was entirely composed of 110 volt dynamos operating on the three-wire system, has had in use for many years rotaries, by means of which one station can relieve another when overloaded, or can help to distribute equally the power from one generating center to another without the necessity arising for the erection of new power houses, except through the natural causes of greatly increased demand.

THE HUMMING OF ELECTRICAL MACHINES.*

Machines of modern design are liable to be more or less noisy, the sound varying from a whistle to a howl, according to circumstances. That it is not merely an air vibration which is in question may be safely admitted, from the fact that the noise usually stops as soon as the excitation is taken off. Also, the same results may be noticed on machines having wide open slots and those having very narrow or half-closed ones. Though this humming is in itself quite harmless, it is very disagreeable when the machine has to work near occupied houses, and cases have occurred in which an otherwise satisfactory machine has had to be replaced, due to this cause alone. In stating above that modern machines are liable to this trouble, reference was intended more especially to those having laminated poles, small air-gaps (1.5 mm. to 3 mm.), and few slots. The difficulty is, in practice, found far less frequently in the older machines having air-gaps of 4 mm. to 6 mm., solid poles, and numerous slots. It may be mentioned at once that the pitch of the note, as would be expected, depends directly on the number of teeth, whilst the amplitude of the sound falls as the number of teeth increases. Already with 13 to 15 slots per polar arc practically no humming is noticeable, and it disappears entirely with higher numbers. In modern practice much smaller numbers of slots, such as six to nine slots per polar arc, are commonly met with. Experience has, however, shown that with even as low a number of slots per pole as five absolutely silent running is possible under certain conditions, as described below. It happened to be possible, by inserting sheet iron behind the poles, to vary the length of air-gap on certain machines of this sort experimented on, and it was found that, contrary to expectation, this did not appreciably increase the noise.

Whatever the cause of the humming, it is easy to prove that the latter is directly dependent on the number of slots. Of course the actual seat of the noise is not necessarily the armature itself, but may be in the poles, which are set in vibration by the changes in magnetic field corresponding to the different positions of the armature. By means of the tuning fork the above statements may readily be confirmed. The usual tuning fork of commerce is set for the note la of the fourth octave, and consequently makes 440 vibrations per second. The number of vibrations corresponding to other notes may be seen from the following:

Fourth octave: do = 264 vibrations, re = 297, mi = 330, fa = 352, sol = 396, la = 440, si = 495 vibrations.

Fifth octave: do = 528 vibrations, re = 594, mi = 660, fa = 704, sol = 792, la = 880, si = 990 vibrations.

Sixth octave: do = 792 vibrations, re = 891, and so on.

It is, therefore, only necessary to determine the note by means of the tuning forks, which should offer no difficulty to a fairly musical ear, and at the same time take the speed of the machine. Dividing the number of vibrations corresponding to

*Translation of an article by J. Fischer-Hinnen in the "Zeitschrift fur Elektrotechnik." From the "Electrical Engineer," London.

the note by the number of revolutions per second, the result is the number of vibrations per revolution, which, naturally, must vary directly with the me-

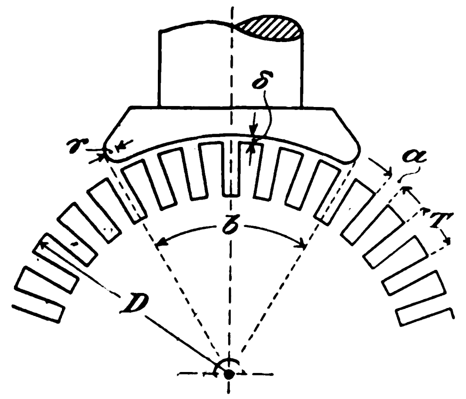


FIG. 1.

chanical or magnetic variations to which these vibrations are due. A few examples will make the matter clear. A 11 hp. motor running at 1,070 revolutions per minute, or 17.8 per second, was found to give the note exactly midway between sol and la of the fifth octave, and corresponding to $\frac{792 + 880}{2} = 836$ vibrations per second, so that the vibrations per revolution are $\frac{836}{17.8} = 47$. As the number of slots in this motor was 47, there can be no doubt the initial cause of the humming lies in the armature slots.

The same experiment was made on a 4.5 kw. dynamo running at 1,400 revolutions per minute, or 23.46 per second. In this case the note was determined with great exactness, and was found to be midway between la and si in the fifth octave, and gives $\frac{880 + 990}{2} = 935$ vibrations per second, or $\frac{935}{23.4} = 40$ per second i. e., exactly as many as the number of armature slots.

The pole shoes of both machines were next reduced somewhat in span, and this almost extirely stopped the humming. When the pole span was still further reduced the humming commenced again. Other machines tested in the same way with various pole widths and different armature slots (see table) confirmed these results—i. e., a distinct ratio of pole span to slot pitch could be found at which the humming was a minimum. The explanation for this is, as already mentioned, that the total flux passing through the pole varies according to the relative position of the armature and the poles, and, within certain limits, according to the ratio of slot pitch to polar span, and this causes the pole shoes to vibrate. In accordance with this view the amplitude of the vibrations should be a minimum when the pole span is an exact multiple of the slot pitch. As a matter of fact, this rule in no way agrees with the test results, obviously owing to the effect of fringing of the lines at both sides of the pole-piece.

PARTICULARS OF MACHINES ACTUALLY CONSTRUCTED (see Fig. 1).

No.	Armature diameter, D.	Single air-gap, δ.	No. of slots, N_1.	Slot pitch. T.	Slot width, *a*.	Polar arc, *b*.	Radius of rounded tips, *r*.	K_1.
1	200	1·5	39	17·1	7	120·2	4·7	6·84
2	230	1·5	47	15·6	6	130·5	5	8·15
3	230	1·5	40	18·3	8·5	130·5	5	6·95
4	·250	1·5	47	16·9	6·5	139·9	5	8·06
5	270	2	45	19 1	8·5	155	5	7 94
6	270	2	49	17·55	8·6	145	5·1	8·05
7	310	2	43	23	9	170	7	7·18
8	310	2·5	43	23	9	165	7	6·96
9	340	2	57	18·95	8	195·2	8 5	10
10	470	2·5	76	19 65	--	190	1	9·7
11	490	3	72	21·61	—	195	1	9·0
12	540	3	73	23·5	—	215	1·5	9·1
13	800	4	48	51·5	24	200	—	3·9
14	200	1·5	29	22	9	104·8	4·5	4·62
15	230	1·5	47	15·6	6	120·5	6	7·45
16	230	1·5	40	18·3	8·5	125·5	7	6·6
17	250	2	53	15	6·5	144·8	5	9·4
18	270	2	45	19·1	9	150	7	7·6
19	340	2	88	12·3	5·5	195·2	8·5	15·4
20	340	2	99	10·9	5·5	195·2	8 5	17 35
21	440	3	117	12	5·5	239·5	9·2	19·4
22	440	3	75	18·7	8	239·5	9·2	12·45
23	370	2	93	12·6	6	205	8·5	15·8
24	400	2·5	86	14·8	7·5	214	9	14
25	400	2	87	14·6	6·8	214	9	14·2

REMARKS.—Nos. 1 to 13, bad humming; Nos. 14 to 25, no humming. Nos. 4, 6, 8, and 18 had slanting poles.

The writer has attempted to establish a rule, and, so far as his experiments go, the best results would seem to be obtained when the polar arc is made such that the slot pitch (reduced to the diameter of the bore) divides into it an exact number of times + .5. There is, of course, difficulty in deciding what to call the polar arc when the pole tips are rounded, and in such cases the writer employs the extreme outer pole span less .7 of the radius of the rounded tip. Stated algebraically, the rule for minimum humming is:

$$\frac{b - .7\,r}{(D + 2\,\delta)\,\pi} \cdot N_1 = \text{a whole number} + .5,$$

where N_1 is the number of slots, and the meanings of the other letters can be obtained from Fig. 1. The more closely this quotient approaches to a whole number, the greater is the danger of humming, except when the number of slots is very great—i. e., over 13 to 15 per pole span.

This table shows that the rule given checks fairly well with the experimental results, except in the case of the three last machines, which, however, have a very large number of slots, and this alone may account for their behavior. In spite of this agreement, however, the writer does not consider the rule to be absolutely reliable, as it takes no account of the slot width. If we consider the slot width reduced indefinitely, we arrive at a smooth-cored armature, which certainly does not hum, and yet the rule would show the contrary. In view of the importance of the matter, the writer hopes that others engaged in dynamo manufacture will test the accuracy of the above rule.

ELECTRICITY FROM WATER POWER.*

BY A. A. CAMPBELL SWINTON.

It should be gratifying to our national pride to know that probably the very earliest example of the production of electricity by means of water power on a practical scale, and its transmission to a distance, was the installation put up for the purpose of lighting at Cragside, Northumberland, by the late Lord Armstrong, in the year 1882. This plant, which was still in daily use in 1884, when the author saw it in operation, consisted of a Siemens continuous current dynamo, which was driven by means of a belt off an 8 hp. water turbine operating with a fall of 30 feet; the electricity, which was delivered at 90 volts pressure, being carried by bare overhead wires attached to porcelain insulators on poles to the house, about a mile distant. It is an interesting fact that when the installation was first put to

*Abstract of paper read before the British Association at Cambridge, Eng., August 22, 1904.

work, it was designed to operate with only a single wire, connection being made to the hydraulic power pipes at the one end and to the ordinary household water pipes at the other, the earth being expected to form a sufficient return in the manner employed in telegraphy. This plan, which was adopted on the advice of the late Sir William Siemens, was found to be quite ineffective, as, owing to the low voltage employed, and the exceedingly rocky nature of the ground, no useful amount of electricity could be transmitted, until the earth return was done away with and a second metallic conductor substituted.

Though this 22-year old English example of electricity developed by water power and transmitted to a distance was, as already mentioned, probably the first such installation in existence in the world, the great development of such installations has, up to recently, taken place almost exclusively abroad. No doubt, up and down this country a very considerable number of small electric plants operated by water power have been put up for private house lighting and such like purposes, and there are even towns—such as, for instance, Salisbury and Keswick—where water power has for long been employed to assist steam power for electrical production for public and private lighting, the water power being in these instances found of great value for the purpose, more especially of maintaining the supply during the periods of minimum load. A few hundred horse power will, however, probably cover the whole of the plants of this character at present running in Great Britain, which is an altogether insignificant amount compared with the much larger corresponding figures for the continents of Europe, America and other countries.

To obtain accurate statistics as to the amount of water horse power at present employed for electrical production throughout the whole world is a very difficult matter, as in many countries no figures are available, while in others such as are obtainable are not up-to-date.

The following table, giving an aggregate horse power of nearly one and a half millions, comprises all the hydraulic electricity works of which the author has been able to obtain particulars. He has, however, no doubt that there must be many others in existence to which he has not been able to find any reference; while again, in the case of a number of the installations which have been included, the horse power now employed is greater than that in use at the time that the statistics were made out:

WATER POWER ELECTRICITY INSTALLATIONS.

	Horse power.
United States of America	527,467
Canada	228,225
Mexico	18,470
Venezuela	1,200
Brazil	800
Japan	3,450
Switzerland	133,302
France	161,343
Germany	81,077
Austria	16,000
Sweden	71,000
Russia	10,000
Italy	210,000
India	7,050
South Africa	2,100
Great Britain	11,906
Total horse power	1,483,390.

It therefore seems reasonable to suppose that the total amount of water power actually used for electrical production throughout the world at the present time must exceed 2,000,000 hp., which is about double the total steam power at present devoted in Great Britain and Ireland to the same purpose.

It is interesting to calculate what would be the amount of coal required to produce this large amount of horse power were it generated by steam engines in the ordinary way—in other words, what is the saving of coal that the adoption of this amount of hydraulic power entails. Many of the hydraulic plants, particularly those which are used for chemical processes, operate at full power continuously night and day, but others work for shorter hours. Assuming, however, that the whole 2,000,000 hp. is in use for 12 hours per diem—in other words, is employed on the average with what engineers call a 50 per cent. load factor—and assuming, as is reasonable, that were the energy produced by means of coal, at least 3 lbs. of this fuel would be required on the average per horse power hour, we get 5.86 tons of coal per horse-power year, or 11,720,000 tons of coal saved anually on account of the 2,000,000 water horse power utilized. Though this may appear a large figure, it amounts to less than 2 per cent. on the total output of coal in the world, which, on the average of the last five years, was 632,000,000 tons per annum. Assuming, however, an average cost of coal of 10s. per ton, this 11,720,000 tons represents £5,860,000 yearly, an amount which would take over £100,000,000 of capital earning 5 per cent. per annum to provide.

Apart from mere magnitude, many of the more recent examples of hydro-electric engineering abroad, especially in America, are interesting by reason of the enormous distances over which the electric energy is being economically transmitted, and the very high electric pressures that in numerous cases are being successfully employed.

The longest distance over which transmission has so far been commercially effected is probably the 232 miles of line belonging to the California Gas and Electric Corporation, which stretches from the de Sabla power house via Cordelia to the town of Sausalito, which is situated on the opposite side of the Golden Gate Straits from the city of San Francisco. The same Californian company also owns the Colegate and Oakland transmission line, which runs 142 miles from the Colegate power house, where 14,000 hp. is developed from a head of water of 702 feet.

Another very long line is that which reaches from the electric power house via Stockton and Mission San Jose to San Francisco, a distance of 147 miles, over which 10,000 hp. is being delivered regularly. This line belongs to the Standard Electric Company, who have 217 miles of power line, with a capacity of 27,000 hp. in operation. The voltages employed, as is to be expected having regard to the distances covered, are very high, ranging from 55,000 to 67,000 volts, 60,000 volts being apparently the standard figure for many recent installations.

Mention should be made of the 50,000 hp. and the 125,000 hp. plants for the Canadian Niagara Power Company and the Electrical Power Company of Ontario, contracted for by the Canadian General Electric Company, both of which will employ pressures ranging up to 60,000 volts; while to pass to another quarter of the globe, the Cauvery Falls electric power scheme in India has now been at work for over two years, and transmits 5,000 hp. to the Mysore gold mines, a distance of 92 miles, using a pressure of 35,000 volts.

Turning now to the British Isles, the only large-scale plant for the production of electricity by water power at present in operation in this country is the well-known installation of the British Aluminum Company at Foyers. This installation has been at work ever since the year 1896, and the whole of the power is employed for electro-chemical purposes on the spot. A small percentage of the power is utilized for the production of calcium carbide, but the bulk is, and in the near future the whole of the power will be, used for making aluminum. At present the gross horse power of the plant is 7,000

hp., but a plant for a further 2,000 hp. is at the present moment being installed, and will be working in about a month's time.

The water is derived from the River Foyers, which has a catchment area of upwards of 100 square miles. Storage is effected by means of two lakes, which have been joined together by the raising of dams and embankments, the result being a continuous lake of about 5½ miles long by about ½ mile in width. The storage thus obtained is sufficient to run the entire plant continuously day and night for about 50 days.

From the River Foyers the water is first passed through a tunnel 8½ feet in diameter, cut through the solid rock, to the penstock chamber, from which the water is delived by separate cast-iron pipes to the turbines, which are installed on the shore of Loch Ness, and into which the water is finally discharged, the available head of water being 350 feet.

The British Aluminum Company have recently obtained Parliamentary powers for a further large water-power installation on Loch Levan. It is their intention to commence immediately the development of this scheme, which is capable of giving 17,000 gross horse power. The reservoir is artificial, and will contain about 150 days' storage of the full power, the head of water at the turbines being 964 feet. It is anticipated that the whole of this power will also be taken up in the manufacture of aluminum on the spot, no distant transmission being, at present, at any rate, contemplated. Another interesting water power scheme of considerable dimensions is at the present moment being developed in Wales by the North Wales Electric Power Company, who have obtained Parliamentary powers for this purpose. Their first installation is at present being erected and derives its power from Lake Llydaw, on Snowdon. This lake, into which runs the water from Lake Glaslyn, is about 1⅛ miles in length, and about a quarter to half a mile in width. Its area is 5½ million square feet, and it derives its water from a catchment area of about 1¾ square miles, including the summit of Snowdon. Being in the track of the Atlantic depressions, this area has one of the heaviest rainfalls in Europe, amounting on the average to 180 inches per annum. In 1903 it reached the phenomenal figure of 250 inches. The prevailing winds are from the sea, and the atmospheric moisture is driven up the sloping side of the mountain, and on being condensed at the summit is discharged in the form of rain or snow on the eastern side over Lakes Glaslyn and Llydaw. The fall of the year gives the wettest months, and it happens that the quantity running from the lakes in spring is averaged up by the snow melting on the sheltered eastern side.

By means of a dam, about 100 feet in length, the level of the lake is to be raised 20 feet. The water will be drawn from the lake by means of a tunnel 600 feet in length, at a point 30 feet below the present level, or 50 feet below the level when the dams are completed, with the result that there will be sufficient storage for meeting a 90 days' drought. The total fall utilized will be about 1,150 feet, and the total horse power available, on the basis of a 9 hours' working day, is calculated at 8,200. The first installation consists of two steel pipe lines and four 1,000 kw. sets, each consisting of a double tangential water-wheel coupled to a three-phase alternator giving 11,000 volts at 40 periods per second.

The company will develop the full horse power of Lake Llydaw before preceeding further, but they have also acquired a furthur water power at Llyn Eigiao, in the Conway Valley, where a fall of 800 feet is obtainable, and where it is calculated that there will be nearly twice as much horse power available as there is at Llyn Llydaw.

One of the first objects of the North Wales Electric Power Company, as soon as their installation is completed, will be to supply energy for the working of certain light railways which they control in the district. It is, however, in addition, intended to supply electric energy throughout a large area, comprising the whole of the counties of Carnarvon, Merioneth, and Anglesea, and also a portion of the county of Denbigh.

Three-phase currents are to be used, and the transmission lines will be of bare copper wires, .324 inch in diameter, carried on insulators triangularly placed on wooden poles. A large proportion of the transmission lines will be carried along the track of the above-mentioned light railways. Lines are to be laid to the principal slate quarry districts of Nantlle, Llanberis, Penrhyn and Festiniog, where a considerable demand for power exists. The distances from the power station to these places range from 6 to 12 miles.

The latest water-power electric scheme in the United Kingdom is that of the Scotch Water Power Syndicate, who have by agreement obtained from Lord Breadalbane and the trustees of the Colquhoun estate of Luss important water power concessions. These agreements have been negotiated by Mr. E. Ristori, who, it may by mentioned, was one of the original founders of the Falls of Foyers installation, while the engineering and electrical details have been worked out by Mr. William Vaux Graham and the author.

The first power that it is proposed to develop is one connected with Loch Sloy, which is situated some 5 miles north of Tarbet, on the side of Ben Vorlich, between Loch Long and Loch Lomond. Loch Sloy, which is situated some 757 feet above Loch Lomond, which, in turn, is some 26 feet above the sea level, is fed from a catchment area of about 3,801 acres, which includes one side of Ben Vorlich, which, with its 3,092 feet, is one of the highest mountains in Scotland. The district has the very heavy rainfall of some 74 inches per annum, of which it is calculated that 60 inches will be collectable.

From the loch the water will be taken in the first instance along an open conduit 3,650 yards in length, which will follow the contour line round Ben Vorlich till a point is reached almost immediately above the position where the power house will be constructed on the shore of Loch Lomond, at a spot called Inveruglas. From the end of this conduit to the power house, the water will be conveyed in steel pipes, the length of the pipe line being about 600 yards, and the height of fall 700 feet.

From the power house an overhead transmission line is to be constructed in duplicate for the purpose of conveying the electric energy to the industrial areas of the Vale of Leven and the Clyde, which comprises the towns of Dumbarton, Helensburgh, Renton and Alexandria, and includes shipbuilding yards, engineering and dye works, calico printing works, and factories of various descriptions, many of which have already intimated their desire to be supplied. The transmission line, for which private way-leaves have been obtained throughout, will be overhead on poles, starting from the generating station at Inveruglas, and continuing across country for a distance of 22 miles to a sub-station which will be situated at Renton, about midway between Dumbarton and the foot of Loch Lomond, in the center of the Vale of Leven industrial area. At the sub-station the voltage will be reduced from the 40,000 volts which it is proposed to employ for the long-distance overhead transmission, to some 6,000 or 10,000 volts, it being the intention that the distribution from the sub-station to the various works shall be underground. We get into rather populous areas here, and it was not thought

that it would be safe to run the wires overhead.

The following are the efficiencies which it is calculated will be obtained:

	Full-load efficiency.
Open conduit.. / Pipe line .. / Turbines ..	75 per cent.
Three-phase generators....	94 "
Step-up transformers......	97 "
High tension transmission line....................	93 "
Step down transformers	97 "
Underground distribution (say, 6,000 volts average).	"
Total efficiency........	58.6 per cent.

This is on the assumption of the energy being delivered to customers at 6,000 volts. If, as is probable in most instances, it will be delivered at lower voltages, there will be a further transformation, the efficiency of which will be 95 per cent. in the case of transformation in pressure only, and 86 per cent. in the transformation of continuous current, making the total over-all efficiencies: 55.6 per cent. for three-phase current delivered, and 50.3 per cent. for continuous current delivered.

So soon as a market has been found for the total power procurable from Loch Sloy, it is intended to utilize a further water power—for which the rights have also been obtained—at Ardlui, about two miles further up Loch Lomond. This power is also fed by a small loch with an available fall of 800 feet, the horse-power obtainable being about half that available at Loch Sloy. The Scotch Water Power Syndicate have, in addition, obtained the rights to still further water powers that exist further north on the Breadalbane estate, and these will be utilized as soon as the demand for power justifies the capital expense. It is because of these additional powers, which will considerably extend the length of the transmission, that it is proposed from the start to employ so high a pressure as 40,000 volts.

It is estimated that the total cost of the Loch Sloy scheme, including the transmission line and the distribution to the various factories, will not exceed £200,000, which, on a basis of 5,000 hp. delivered, works out at about £40 per horse power, everything included. Seeing that many of the existing electric generating stations worked by steam have cost almost this amount for land, buildings and generating plant, this does not appear to be an excessive figure, and it may be pointed out as an interesting fact that the 20 miles of overhead transmission line only accounts for some £24,000, or about 12 per cent. of the total expenditure. This, coupled with the fact that the calculated loss on the transmission line at full load will only amount to about 7 per cent., and the step-up and step-down losses to another 6 per cent. making 13 per cent. in all, will give some idea of the extent to which the length of the transmission line is but a comparatively unimportant factor in schemes of this description. It may be pointed out, further, that the above-mentioned line loss of 7 per cent. is upon the basis of only one of the two duplicate transmission lines being in use. When both are employed the line loss will be reduced to 3½ per cent., and the total transmission loss at full load will be only a little over 10 per cent.

The main transmission will be on the three-phase system over two sets of three copper conductors, each about three-tenths inch in diameter, the possibility of conveying as much as 5,000 hp. over a distance as great as 22 miles with only 3½ per cent. loss by means of such comparatively small wires being, of course, due to the high pressure employed. Indeed, using pressure as high as 40,000 volts, when it is a matter of transmitting comparatively small amounts of power, as, for instance, the 600 hp. or thereabouts that under the present scheme it is expected will be required for the supply of Helensburgh, the interesting point arises that the minimum size of conductor allowable is limited, not by electrical conditions, but by considerations of mechanical strength.

On the main transmission line the conductors will be carried at a minimum height of 40 feet from the ground, while at all crossings over roads they will be inclosed in a wire cage to meet the Board of Trade requirements for ensuring public safety.

The application of water power in the United Kingdom can, of course, never attain the dimensions that it has already reached in America and elsewhere; still, the above brief account of what is at present being done in Scotland and in Wales show that there are possibilities even in this old country of which till recently but few were aware.

As regards the economies of electrical generation by water power, no general rule can, of course, be enunciated, and every case must be dealt with on its merits, according to local circumstances. This, notwithstanding it is possible to give an indication of what is generally involved having regard more especially to the fact that with water power, as a rule, interest on capital plays a much greater part in determining the cost than do labor or upkeep.

Avoiding, on the one hand, small powers where the costs are likely to be abnormally high, and on the other very large powers, such as we do not possess in this country, it may be taken generally that interest on capital, depreciation, upkeep, and working expenses in this country will amount to about 12 per cent. on the capital expenditure.

On this basis it is easy to see that to be economically sound the capital involved must not exceed 8½ times the annual price which can be got for the whole of the energy. For instance, if 5,000 hp. is available for sale, and £6 can be got for each horse power on the average per annum, the capital involved must not exceed £52 per horse power, or £260,000 in all.

To conclude, it has been said that the greatest benefactor to the human race is he who makes two blades of grass to sprout where only one grew before. On this principle, the utilization of natural water power is obviously to the public advantage. When mechanical or electrical energy is generated by the burning of coal, it is a matter of the consumption, not of interest, but of capital. On the other hand, every water horse power that is put to use is something added, mundanely speaking, for all time, to the permanent resources of mankind.

ON LARGE BULB INCANDESCENT ELECTRIC LAMPS AS SECONDARY STANDARDS OF LIGHT.*

BY J. A. FLEMING, M.A., D.SC., F.R.S.

(*Continued from page 163.*)

The writer recently had careful tests made to ascertain if these large-bulb incandescent lamps gave the same candle power at the same voltage and current, irrespective of variations in the temperature of the surrounding atmosphere. With this object an experiment was made by Mr. G. B. Dyke in the photometric gallery of the Pender Electric Laboratory, at the suggestion of the author. A large iron box was provided, having an oval hole in front, about the size of one of the large bulb lamps. A lamp of this description was mounted on a socket and suspended in this box with its axis vertical. At the bottom of the box were placed some coils of iron wire which could be heated by an electric current. In this manner the temperature of the air in the box was gradually raised and the lamp was surrounded by an atmosphere of warm air. The temperature of this air was taken by four thermometers placed in the box. The readings of these

*Paper read before the British Association at Cambridge, Eng., Aug. 22, 1904.

thermometers were taken together with the candle power of the lamp, and the values found to be as follows:

—Atmospheric temperature in centigrade degrees.—					Candle power of large-bulb lamp.
(I)	(II)	(III)	(IV)	Mean.	
23.6	24.4	22.8	22.8	23.4	13.84
27.4	27.7	28.0	26.4	27.4	13.81
42.0	44.4	46.9	37.5	42.4	13.81
67.2	69.4	77.2	53.3	66.8	13.77

Hence it is clear that there is practically no change in the candle power of the lamp with change of temperature of the surrounding atmosphere.

These lamps, therefore, present the following valuable features when employed as secondary standards of light: (1) The candle power does not vary with the atmospheric moisture, barometric pressure, or atmospheric temperature. (2) If the lamp is properly prepared and used as described, the candle power given by it depends on nothing but the current passing through the filament and this last can be measured to within 0.1 per cent. or less by means of a potentiometer, and the candle power, therefore, known to within 1 per cent. The experience so far gained shows that if a number, say six, of these standard photometric lamps are kept and compared with one another at intervals, the observer has always the means at his disposal of determining the candle power of an incandescent lamp within 1 per cent. (3) Great portability as a standard. The lamp is very portable, and there is no difficulty in sending these lamps suitably packed to the other side of the world. Anyone with secondary cells as a source of current and a potentiometer as a measuring instrument has the means of setting up a standard of light at least as accurate and constant as a good flame standard. These lamps, in fact, afford the best means of determining the variation of flame standards with barometric pressure and atmospheric moisture, and photometric comparisons between a large bulb lamp as devised by the writer and a flame standard is, in fact, a checking of the latter by the former and not the reverse.

In equipping an electrical laboratory with the means of preserving a standard of light, the author recommends the following procedure as the result of eight years experience of it. A stock, say of twelve of the large bulb photometric lamps is provided. Those of the writer's pattern issued by the Edison and Swan United Electric Light Company are each sent out in a stout millboard box. These lamps should all have their candle power carefully determined at a marked voltage, so chosen that the efficiency is about 4 watts per candle. The current at this voltage should be measured. This candle power, current and voltage should be marked on the box. If this calibration is made against a flame standard, then the greatest care should be taken to correct the value of the flame standard for atmospheric moisture and pressure. The candle power ratios of these lamps should be taken, and six of them should be preserved as ultimate standards of reference for the adjustment of the other six. These last may be used for setting the comparison lamp in the photometer, and they should be compared at intervals with the first six lamps which are reserved as prime standards of reference. If the six working lamps are used turn-and-turn about, and inter-compared with the reference standards, they may be used thousands of times without being actually burning for more than a few hours, and the tradition as to the limit of light or illumination can be transmitted without risk of change.

(To be continued.)

International Association of Municipal Electricians.

The following officers were elected at the convention of the International Association of Municipal Electricians, held at St. Louis, Mo., September 14:

President—W. M. Petty, Rutherford, N. J.

First Vice-president—J. B. Yeakle, Baltimore, Md.

Second Vice-President—G. H. Holderman, Indianapolis, Ind.

Third Vice-President—C. E. Diehl, Harrisburg, Pa.

Fourth Vice-President—Chas. Greenwald, New Brunswick, N. J.

Treasurer—G. F. Macdonald, Ottawa, Can.

Secretary—F. P. Foster, Corning, N. Y.

Executive Committee: J. Murphy, Cleveland, O.; Wm. Crane, Erie, Pa.; M. J. Donohue, Niagara Falls, N. Y.; A. S. Hatch, Detroit, Mich.; C. L. Williams, Laurel, Miss.; A. C. Farrand, Atlantic City, N. J.; W. H. Thompson, Richmond, Va.; F. C. Mason, Brooklyn, N. Y.; J. S. Craig, Toronto, Canada.

Finance Committee: W. H. Bradt, Troy, N. Y.; James Grant, New Haven, Conn.; T. C. O'Hearn, Cambridge, Mass.; J. D. Hall, Peoria, Ill.

Next place of meeting, Erie, Pa.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPT 20, 1904

Electric Railways and Appliances

770,342. Insulated Joint. George A. Weber and Percy Holbrook, New York City, assignors to the Weber Railway Joint Manufacturing Company, same place. Filed Nov. 13, 1903.

Electric Lights and Appliances.

770,373. Electric Arc Lamp. George M. Lane, Asbury Park, N. J., assignor of three-fourths to Joseph Ackerman, James D. Carton and Benjamin Albertson, same place. Filed Nov. 21, 1903.

770,489. Electric-Arc Lamp. Louis Wolff, Berlin, Germany. Filed Nov. 25, 1903.

770,529. Display Device for Electric Lamps. William L. Levy and Charles E. Dressler, New York City; said Dressler assignor to said Levy. Filed Dec. 4, 1903.

Electrical Machinery and Apparatus.

770,378. Switch-Operating Mechanism for Electric Motors. James A. Mehrten and John H. Howard, Exeter, Cal. Filed Oct. 6, 1903.

770,456. Electromechanical Switch Mechanism. James A. Duffy and Oscar Irwin, Pittsburg, Pa., assignors of six-tenths to Charles D. Armstrong, same place. Filed Dec. 23, 1903.

770,541. Contact-Breaker. John B. Schug, Detroit, Mich. Filed May 31, 1904.

770,579. Magneto-Generator. Herman Hess, Indianapolis, Ind., assignor to John A. Kurtz, same place. Filed Nov. 10, 1903.

770,631. Motor-Controlling System. Arthur C. Eastwood, Cleveland, O. Filed June 10, 1904.

Telephones and Telephone Apparatus

770,268-269. Telephone Exchange System. William M. Davis, Chicago, Ill., assignor, by mesne assignments, to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed Dec. 2, 1901; May 20, 1903.

770,296. Telephonic Relay. Isidor Kitsee, Philadelphia, Pa., assignor, by mesne assignments, to the Keystone State Telephone & Telegraph Company, Philadelphia. Filed Jan, 8, 1903.

770 377. Register and Alarm Mechanism for Telephone Toll Apparatus. George A. Long, Hartford, Conn., assignor to the Gray Telephone Pay Station Company, Hartford, Conn. Filed Nov. 8, 1902.

770,410. Detachable and Antiseptic Mouthpiece for Telephone-Transmitters. Charles D. Wright, Chicago, Ill. Filed May 4, 1903.

770,424. Switch or Ringing Key for Telephone Switchboards. Lars M. Ericsson, Stockholm, Sweden, assignor to the Aktiebolaget L. M. Ericsson & Co., same place. Filed June 18, 1902.

770,556. Single-Wire Selective Signaling and Inter-Communicating Telephone. John A, Brown, Blythewood, S. C. Filed Oct. 28, 1903.

Miscellaneous.

770,277. Secondary Battery. Lothar Fiedler, Stoke Newington, Eng. Filed June 28, 1904.

770,278. Insulation-Rack. John R. Fletcher, Dayton, O Filed May 14, 1904.

770,303. Electrical Conduit. James B. McGinley. Allegheny, Pa. Filed March 19, 1903.

770,312. Compensating Terminal for Electric Furnaces. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa.. Filed Aug. 6, 1903.

770,322-323. Electric Clock. Herbert Scott, Bradford, Eng. Filed Sept. 17, 1902; May 4, 1903.

770 358. Cell for Storage Batteries. Pietro Figuccia, Boston, Mass., assignor one-half to Louis M. Rossi, same place. Filed Feb. 19, 1904

770,431. Interrupter. Thomas B. Kinraide, Jamaica Plain, Mass. Filed April 6, 1904.

770,432. High-Potential Inductien-Coil. Thomas B. Kinraide, Boston, Mass. Filed May 25, 1904.

770,433. Thermal Inductor. Thomas B. Kinraide, Boston, Mass. Filed May 25, 1904.

770,472. Rheostat. John Nelson, Peru, Ill. Filed July 5, 1904.

770,628. Interchangeable Telegraphic Key. Walter C. Dean, Quitman, Ga., assignor to James H. Mathis and Dunham B. Price, same place. Filed Nov. 30, 1903.

770 668. Wireless Telegraphy or Transmission Through Space. Alessandro Artom, Turin, Italy. Filed Jan. 3, 1903.

THE TELEPHONE WORLD.

Important Centers Reached by Independent Long Distance Lines.

An important commercial movement, involving the establishment of a long-distance telephone service by Independent companies from Baltimore, Md., to Pittsburg, Pa., is being seriously considered, and already a conference of the companies which are planning to undertake the project has taken place at Keyser, W. Va.

Officials of the Maryland Telephone Company in Baltimore, the Piedmont & Keyser Telephone Company, the Garrett County Telephone Company and the Somerset Telephone Company were present at the conference, as well as Philadelphia telephone men, to whom the plan under consideration is of great business concern. The Maryland Company is now building a line from Baltimore to Romney, W. Va., where it will connect with the Piedmont & Keyser Company's wires; which, in turn, will connect with the Garrett County lines. This company recently absorbed what was known as the West Virginia, Maryland & Pennsylvania Company's lines, and covers the whole of Garrett County, Md., and portions of Preston and Tucker Counties, W. Va. The Somerset Company's system will cover the intervening space from Oakland to Pittsburg.

The Southwestern Telegraph & Telephone Company is making very extensive improvements in its Sherman, Tex., office, including the placing of switchboards, increasing the present capacity one-third. Several long-distance lines are being added, including one to Dallas, which, will detour from a direct course, taking in many points not at present reached by the service. Many thousands of dollars will be expended in the improvements now in contemplation.

The special committee of the council on the telephone service for Brantford, Ont., lately resolved by a vote of four to two, to commence the construction of a civic telephone system at an estimated cost of $37.000. This matter has been under consideration for several months, and the committee visited Port Arthur and Fort William in connection with the proposal.

The Tristate Telephone Company of Connellsville, Pa., has let a number of contracts for extending its service throughout Fayette County. The principal one of these was extending the line to Brownville by a private right-of-way.

The Interocean Telephone Company will establish a toll and pay station at Holley, N. Y. The plant will be thoroughly up-to-date in every respect with all the latest improvements.

It has been decided by the courts that a telephone company has the right to enjoin the moving of a building that interferes with its lines. This was in the case of the Northwestern Telephone Exchange Company vs. Anderson, recently decided by the Supreme Court of North Dakota.

Telephones are increasing in Africa. Nearly 800 miles of wire have been put up in Abyssinia, and 1,000 more are in process of construction.

Entire Plant of Stromberg-Carlson Company in Rochester, N. Y.

The principal departments of the Stromberg-Carlson Telephone Manufacturing Company in Chicago were ordered closed down a short time ago and the work of removing the machinery to Rochester was at once begun. That city now possesses the largest Independent manufactory of telephones and telephone supplies in the world.

By October 1 the establishment will be manufacturing entire the latest telephone instruments, all kinds of cables and switchboards, and every kind of telephone supplies. The entire force numbers about 2,000.

Telephone War Likely.

The Stoddard Telephone Construction Company, of Monroe, Mich., has begun work on the exchange, and it will be in operation by October 1. The company has of late been building many farmers' lines, and all of these will center in the exchange at Monroe. Direct connection with the Home Telephone Company, of Toledo, will be made, and it will be possible to reach that city otherwise than by the Bell lines, which have heretofore had a monopoly. The company also holds a franchise from the council for a local exchange, and it is expected that one will be put up before long. If this is done a telephone war between the two companies is anticipated.

The Manokin Telephone Company of Somerset County, Md., has been organized for the purpose of owning, leasing, constructing and operating a telephone line or lines, with the principal office at Oriole, with a capital stock of $5,000. The incorporators have filed a certificate of incorporation with the clerk of the court for Somerset County, and the following will manage the business for the first year: Dr. R. L. Hoyt, Albert B. Fitzgerald, Isaac G. Parks, William L. Muir, George W. Bozman, and Josiah P. Muir.

The net output of the American Telephone & Telegraph Company increased 34,303 instruments during August, as compared with the same month of last year.

The new telephone line which is being constructed to connect the villages of Clifton Springs and Newark, N. Y., is nearly completed. It will carry 10 copper wires between these villages, and is called standard construction.

A new telephone franchise was lately granted to L. J. Pettijohn and others at Dodge City, Kan., to erect another telephone line which will be commenced immediately and completed in a year. The city asserted that the present company had not lived up to the its contract.

A new company has been organized in St. Lawrence County, N. Y., known as the Madrid Telephone Company, with a capital stock of $10,000. G. P. Horsford and J. L. Young, of Madrid, and T. F. Rutherford, of Waddington, are the directors.

The Lake Shore & New York Central completed their telephone system from Chicago to this city last week.

Railroad Companies to Use Telephone Service.

Superintendent of Telegraph E. A. Chenery, of the Iron Mountain Railroad, has installed telephone communication between Jenny Lind and Van Buren, Ark., by tapping the telegraph wire extending from Coffeyville, Kan., to Greenwood, Ark. The use of the wire as a telephone does not interfere with sending messages by telegraph, and affords a great convenience. At Jenny Lind the superintendent of the coal mines has telephone communication with the office of Superintendent J. D. Moore, of the Iron Mountain at Van Buren. Touching a push button at either end of the line will ring a bell at the other end, and conversation can be carried on as easily as over a local telephone wire. The line is about 20 miles long. Several railroads have been using this system for short distances. In this case the wire has been tapped between terminals, with 165 miles on one side, and five miles on the other.

The Erie Railroad Company has asked telephone equipment companies in Cleveland, O., and other cities in the East, for estimates on the cost of installing a complete telephone system between Cleveland and New York. The Erie management, it is understood, has been contemplating establishing Independent telephone communication between its western and eastern terminals for some time, and its plans have so far progressed as to warrant invitations of estimates.

The Lamonte Telephone Company was organized lately in Lamonte, Mo., with a capital stock of $6,600. The following officers were elected: President, W. E. Piles; vice-president, F. Wimer; secretary, J. A. Fleming; treasurer, John McCurdy. The new company will build an Independent exchange with country lines.

Work on the new telephone line connecting the villages of Castle, Silver Springs and Gainesville, N. Y., is nearing completion and the rentals will commence October 1.

The board of directors of the Providence, R. I., Telephone Company, at a recent meeting, decided to increase the capital stock of the corporation from $1,600,000 to $2,000,000.

A telephone line will be constructed between Victoria and Mission Valley, Tex. The secretary of the Business Men's League can give information.

The Kitchawan, N. Y., Telephone Company was lately incorporated with a capital of $1,000, by E. G. Van Pein, H. B. Forman and J. B. Erhardt, of Kitchawan.

Telephone Incorporations.

The Findlay Mutual Telephone Company, Findlay, Ill. Capital stock, $2,400. Incorporators: Stephen D. Dole, William B. Wallace and John W. Coventry.

The Zumbro Falls Farmers' Telephone Company, Zumbro Falls, Minn. Capital stock, $7,000. Incorporators: Frank Robertson, Bert W. Disney, Charles Anding, Albert Sugg, Albert Robertson, John C. Brinkman, James Ross and Jacob J. Springer.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Baraboo, Wis.—A new electric plant has been ordered here by the Nortwestern road.

Benton, Ill.—The city electric plant here was destroyed by a recent fire. The loss is estimated at $7,000.

Caddo, Tex.—The plant of the Caddo Cotton & Power Company has been damaged by fire. The dynamo that was run for the Caddo electric light plant was ruined, and the engine and boiler damaged. The loss is estimated at $5,000.

Dayton, Tenn.—The board of mayor and aldermen lately modified the contract with Thomas E. Stone, and Mr. Stone will begin at once to rebuild the electric light plant which was destroyed by fire a few days ago.

Dublin, Ga.—A special election will be held October 10 to vote on the issuance of $45,000 bonds, $3,000 of the same to be used for improving the electric light plant.

Dyer, Tenn.—The Dyer electric light plant, which was lately destroyed by fire, is to be rebuilt.

Earlham, Ia.—Electric lighting is proposed for this place.

Glendale, Ore.—This town will soon have a new water system, and a fine electric light plant.

Gridley, Ill.—The proposition to light this town by electricity is being discussed.

Guadalajara, Mex.—Gov. W. T. Thornton has applied for a franchise here to establish a complete electric street light service.

Helena, Ga.—The city council is receiving bids for the construction of a system of electric lights and waterworks.

Ilion, N. Y.—The proposition to bond this village for $25,000 for electric light purposes was lately carried.

Kansas City, Kan.—The electric light plant here was lately destroyed by fire.

La Grange, Ga.—A bond election was recently held here to decide whether or not the city should own and control its own electric light and power plant, equip a first-class fire department and for other purposes. The election was carried by a safe majority. The city will shortly issue $40,000 in bonds, $25,000 of which will go to build and equip an electric plant, and $5,000 for a fire department.

Malvern, Ark.—This town is to have a new electric light plant.

Mason, Mich.—The electric light and water board of this city has recommended to the council that a turbine engine and necessary accessories be purchased for the electric light plant to cost about $7,500.

Mansfield, Mass.—The electric light service here is to be improved.

Newport, Ky.—Two bond issues, one for $100,000 and one for $20,000, for a municipal electric light plant will be voted upon at the November election.

Prescott, Ia.—A local electric light company has been organized at Lenox for the purpose of establishing an electric light plant.

Richmond, Va.—The question of establishing an up-to-date electric light and power plant by the city, for the purpose of furnishing light and heat for municipal purposes, as well as for sale to the public, is one that is receiving attention at the hands of the new council.

Seattle, Wash.—John A. Huffman, of the Washington Real Estate & Building Company of this city, who has for some time been endeavoring to get through the city council of Edmonds a franchise for the Edmonds Electric Light & Power Company, considers that the same will soon be granted.

Shenandoah, Pa.—At a recent meeting of the directors of the Citizens' Electric Light Company of this city it was decided to spend $6,000 or $7,000 in improving the plant. A new dynamo will be placed at the power station and both incandescent and arc lights will be furnished, new wires strung, and the plant given a general overhauling.

Sioux Rapids, Ia.—After many months of negotiation this city has purchased the electric light plant here for $2,000, and will at once have the same fixed up for operation.

Urbana, O.—The Urbana Electric Light & Power Company, which is owned by the Appleyard Syndicate, is contemplating putting in a new plant in this city.

Wayne, Mich.—The citizens have voted to issue $8,000 in bonds for electric lights.

Williston, N. D.—An application has been made here for an electric light franchise.

STREET RAILWAYS.

Auburn, N. Y.—The building of an electric railroad from this city to Port Byron is now an assured fact. The directors are Col. E. D. Metcalf, F. W. Richardson and others.

Bucyrus, O.—An engineering corps is surveying the line of the Bucyrus & Nation Electric Railway, which will be built soon.

Colfax, Wash.—The company organized here last year for the purpose of constructing an electric railway from this city to Palouse, has been working steadily upon its plans ever since, and it is now in a position where it expects to commence active operations. I. B. Harris, president of the Whitman Electric Company, and Charles F. Stuart, secretary, announce that grading will be begun soon.

Colorado Springs, Col.—The Continental Gold Mining Company, capital stock $3,000,000, has been incorporated and will build an electric road from Buena Vista to its mines.

Denver, Col.—The Denver & Interurban Electric Railway is soon to be constructed. J. P. Morgan may back the road.

Detroit, Mich.—The Detroit, Pontiac, Lapeer & Northern Electric Railroad Company is trying to secure the right of way for its new line.

Edgerton, Wis.—The Janesville, Madison electric line has filed an acceptance of the franchise given by the common council of this place.

Everett, Wash.—A franchise was granted by the county commissioners to E. G. Krueger for an electric line from Index to Mineral City.

Ft. Worth, Tex.—The Northern Texas Traction Company will spend about $25,000 in improvements on the North Side.

Greeley, Neb.—The Burlington may build an electric road between Greeley Center and Ericson.

Jacksonville, Ill.—A syndicate from New York, composed of J. S. Hackett, F. J. Waddell and W. W. Ewing, have been working up plans for building an interurban electric line out of this city to Springfield.

Jackson, Mich.—TLe Adrian & Jackson Traction Company, incorporated with a capital of $320,000, will build an electric line between the two towns mentioned. J. W. Helme is one of the directors.

Kewanee, Ill.—Two interurban electric railway companies have started work here. The Kewanee, Cambridge & Genesee line, to be 30 miles long, will connect the cities mentioned. The Galesburg & Kewanee Company will build a local system immediately, and later will connect Galesburg and this city.

La Rue, O.—The new electric line between Richwood and Kenton is being surveyed.

Morelia, Mex.—Plans have been perfected for the construction of an electric railroad, 248 miles long, in Mexico. It is to run from Guadalajara to this city. The Catholic Bank, of the City of Mexico, will finance the scheme. The project of building this road originated with Chicago capitalists several months ago. They gave it up and Mexican capitalists took hold of it and its success is said to be assured.

Plymouth, Wis.—J. M. Seaman, of this city, lately announced that he has signed contracts with a Pittsburg firm to build and equip a power house at Elkhart Lake, to operate an interurban line between here and Chilton.

Selinsgrove, Pa.—It has been announced that this city and Sunbury will be joined by a trolley line, to be owned by a corporation known as the Sunbury & Selinsgrove Electric Railway Company.

St. Peter, Minn.—An electric line is to be erected between here and Kasota.

Sulphur, I. T.—The city council has granted a franchise to the Oklahoma City, Lexington & Sulphur Springs Electric Railway into this place. The Commercial Club pledged $6,000 to the road as soon as it is constructed into Sulphur.

Watervliet, Mich.—Chicago capitalists, said to be closely associated with the Graham & Morton Transportation Company, have purchased the paper mill plant here, and are planning to transform it into a power station for a new interurban electric road.

Whitehall, Ill.—A new company is being formed to build an electric road from here to Bay City. The incorporators are E. P. Kirby, E. S. Greenleaf and others.

POWER PLANTS.

Chihuahua, Mex.—A company to utilize the concession and build a large water power plant to furnish electricity has been organized in the State of New Jersey, with John F. Kelly, of New York, as president. The plant will be built in this city, and will involve an expenditure of $1,000,000.

Lander, Wyo.—R. A. Morse, a mechanic of this place, has succeeded in promoting a plan for the construction of a 1,000 hp. electric plant at the falls of Big Propoagie, about 10 miles from here. The rights have also been secured to the north fork of the river, and machinery will be installed at that point should the power obtained at the Big Propoagie Falls prove insufficient. The company, which is to be incorporated under the name of the Wyoming Light & Power Company, w ll rush the plant to completion.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12½@12¾c.; Lake 12⅝@12¾c.; casting, 12⅜@12½c.

New interests are reported to have acquired control of the Chicago and South Shore Electric line.

The Manhattan Electrical Supply Company of Jersey City has had its capital decreased from $1,000,000 to $750,000.

The Bell Telephone Company of Philadelphia has declared a dividend of 1½ per cent., payable October 15. Books close October 5 and reopen October 17.

The annual meeting of the stockholders of Boston Edison Electric Illuminating Company will be held at the offices of the company Tuesday, October 11.

The Electric Storage Battery Company has declared the regular quarterly dividends of 1¼ per cent. each on its preferred and common stocks, payable October 1.

The directors of the American Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent., payable October 15 to stock of record September 30.

The subway in this city is nearly ready for opening, and railroad men are busy figuring how far it will cut into the business of the surface lines. For a time they claim the loss may be rather heavy.

A controlling interest in the Haverhill Electric Company has been sold to a syndicate now controlling the Malden Electric Company and other similar plants in Massachusetts. The price paid is said to have been $175 per share.

The gross earnings of the Boston & Worcester Street Railway system for the first nineteen days of September were $32,000, and the officials of the company estimate the gross showing for the full month at about $50,000.

There are rumors in speculative circles that Lake Superior Copper is not to be had under 13 cents. It can be stated, however, that rumor is a little ahead of the fact. The best lake copper can still be had in quantity at 12⅞ cents.

The Westinghouse Electric & Manufacturing Company has declared the regular quarterly dividends of 2½ per cent. each on its preferred, assenting and non-assenting stocks, payable October 10. Books close September 30 and reopen October 11.

General Electric offcials claim that the company will probably do $10,000,000 worth of turbine engine work the current fiscal year, and next year it might easily be $20,000,000. The officials figure the General Electric's total business in 1905 is expected to easily exceed $50,000,000.

Action was recently entered at Lexington, Ky., for a receiver for the Blue Grass Consolidated Traction Company, capitalized at $7,000,000, and managed by Senator George B. Davis, of Detroit. It has only partially completed its interurban system in central Kentucky.

At the annual meeting of stockholders of the Union Traction Company of Philadelphia, the retiring board of directors was re-elected. The stockholders ratified to merger into that company of various smaller lines and also approved the placing of a mortgage of $1,000,000 on the property formed by the mergers.

The Luzerne (Pa.) County Gas Company and the Wyoming Valley Electric Light Company have been sold to a syndicate of New York and Philadelphia capitalists. The two companies will be consolidated and the name of the new corporation will be the Wilkes-Barre Gas & Electric Light Company. The new company will have a capital stock of $1,500,000 and an authorized bond issue of $3,000,000.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Sept. 26
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	154¼
Metropolitan Street Railway	119
Metropolitan Securities	78¼
Ninth Avenue	197
Third Avenue	126
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	54¾
Public Service Corporation (New Jersey)	98
Philadelphia.	
Consolidated Traction of New Jersey	72
Philadelphia Traction	97¾
Union Traction	56¼
Boston.	
Boston Elevated	154⅛
Massachusetts Electric Companies, com	13
do. do. do. pref.	59
West End Street, com	91⅞
do. do. do. pref.	111¼
Chicago.	
City Railway	188
North Chicago	71
Union Traction, com	8
do. do. pref.	36
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	11
do. pref.	50
Electric Boat, com	40
do. do. pref.	74
Electric Lead Reduction	¾
Electric Vehicle, com	16¼
do. do. pref.	21⅛
Westinghouse, com	164¾
do. pref.	190
General Electric	171¾
Boston.	
Edison Electric Illuminating	258
General Electric	171¾
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	150
National Carbon, com	35¼
do. do. pref.	109
Philadelphia.	
Electric Company of America	9¾
Electric Storage Battery, com	.65
do. do. do. pref.	65
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140
Western Telephone Company	14
New England Telephone Company	123¾
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	210
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	90¼
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	35
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

Copper Mines and Their Dependence Upon Electricity.

The huge changes taking place in the West owe their inception to the origin and development of great industries, among which none figure so prominently as agriculture and mining. It is many years since the first gold was discovered in California or the first copper in Colorado, yet it may be noted that the swift changes occurring, which swept out of existence the old order of things—the wilderness, the roving tribes of marauding Indians and all that pertained to a primitive civilization—were inaugurated by the systematic and scientific development of the great mining industries, and among these colossal industries none occupy so prominent a place as that of copper mining.

It is not too much to say, when we claim that copper mining, in order to be an economical and not a wasteful process, calls for the application of electricity for the refinement of the ore. In the great mountain ranges of the West many opportunities for the development of water power exist and this power is frequently utilized for the operating of mining machinery, electric lighting, haulage, and the ultimate reduction of the crude copper into metal of the purest quality.

On the other hand, if water power is not available it more than pays to install engines and generators, as it has been shown in the operation of at least one mine in particular, the great Anaconda, that the use of electricity is indispensable to its successful working. To cite this mine as an illustration is profoundly interesting as regards the facts at hand. The Anaconda mine was formerly operated according to the old methods, with the result that the waste was very great in a financial sense. Copper is a metal which is subject to rapid changes during the purely metallurgical processes of purification, and for that reason the by-products are heavy. It was decided to try the electro-chemical method of reduction and in the course of time huge vats were built, generators were installed, and great blocks of crude copper treated by this method. The result was beyond the expectation of the engineers, as great masses of electrolytically pure copper were found deposited at the cathode, and all that remained was a mass of sludge at the bottom of the vats. This mud-like substance for quite a period of time was thrown away, until one of the chemists decided to analyze its constituents. He found to his surprise that it consisted of a heavy percentage of silver and some gold. In the operation of the Anaconda mine to-day it has been stated that this in itself pays nearly all the operating expenses. As a matter of finance little else need be said in favor of the use of electricity in copper mining if under such circumstances all the copper obtained can be regarded as pure profit.

* * *

Locating Ores Electrically.

We referred a short time ago to the new electrical apparatus for locating ores, which had engaged the attention of English electricians and those interested in the iron and steel industries, and of which a public demonstration was given by Prof. Silvanus P. Thompson in London. It is now reported, upon what looks like pretty reliable authority, that the device has shown its suitability for the purpose to which it is sought to industrially apply it in several experimental tests which had been made with it. In at least one case the test was made as much with a view to dissipating the skepticism displayed by some who, with one eye half shut, fancied

that they discovered something of the nature of the water diviner about the invention. When the finder was brought into play at Coniston, it succeeded in discovering the track of lodes of copper whose whereabouts had been for some time more or less a mystery, and had looked like continuing to be so. Later reports which are now circulating in London are to the effect that an even greater success has followed attempts which have been made with it in the Barrow district. It was applied there to ascertain whether or not there were further supplies of hematite deposited.

It is stated that the Barrow Hematite & Steel Company have expended much money during recent years in sinking many shafts and conducting boring operations, in the hope that further deposits would be found so as to prevent the serious falling off in Barrow productions. These attempts were rewarded with little success indeed, and the output of hematite at Barrow fell in the case of one company alone from 16,000 to 2,000 tons per week, many hundreds of men being consequently thrown out of employment. A difficulty which stood in the way of the successful use of the ore-finder where these other attempts had been of no avail, was found in the fact that that the conductivity of hematite is extremely slight—little better than that of the ground. Thus it followed that the same instrument which located copper could not be expected to locate hematite, and specially tuned instruments were prepared. We learn that indications of the presence of large quantities of hematite were soon apparent, and the accuracy of these indications received confirmation when boring operations were carried out, hematite being struck in large quantities within a few feet of the location shown by the ore-finding apparatus. In addition to the Barrow application, it is said that the finder has traced new lead deposits in Wales, copper in Cornwall and gold in Australia, and it is being used in Mexico.

* * *

Our Trade With South American Countries. One of the most notable features of our trade with South American countries is the slight progress that is being made. During the past thirty years there has only been an increase of about 5 per cent. in this trade, the sales for 1890 and 1902 being practically the same. Comparing our trade with other countries outside of South America we find that it has nearly doubled during the same length of time.

A great drawback to our trade is the fact that our traveling salesmen are not acquainted with the language of the people, and a South American feels a great deal more confidence if he is approached in his native language; this is a fact which has always appealed to the European drummer. Another needed improvement is the institution of American banking facilities and large trading concerns; for this our present banking system is largely to blame, in that our national banks are not allowed to have branches outside the country, whereas the English and German trade have branches covering all parts of the field.

Long credits are asked for and granted by the European firms. Americans object to this on the ground of the non-stability of some of the Governments. While this may be wise, yet it would seem that an American firm ought to be able to prosper on the same conditions as a European one. This trade, especially in the electrical line, can be increased by well-directed effort.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

By referring to page 195 of this issue it will be seen that the Government is seeking bids for a large amount of electrical material.

Ex-President Henry L. Doherty is working hard to have Denver selected for the next meeting place of the National Electric Light Association.

The next regular meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West 55th street, New York City, October 28.

One hundred and thirty students have been enrolled for the Electric Night School at Schenectady, N. Y.

It is figured that Japan must have purchased last year $2,000,000 worth of electric goods, mostly from American houses.

A press dispatch says that President Roosevelt had an interesting talk on Saturday with Theodore Feilden, editor-in-chief of "The Electrical Magazine" of London. Mr. Feilden came to America as one of the delegates to the International Electrical Congress recently held in St. Louis, and has visited all the principal industrial centers of the country. "The President," he said at the conclusion of his interview, "manifested the deepest interest in the developments of electrical science, and I found him wonderfully well informed on the subject. My trip to America has been a perfect revelation to me. We in England had heard and read a good deal about the development of electrical appliances in the United States, but before our visit we had no realization of the wonders of that development. The United States is far in advance of any other country in the application of electricity to commercial and industrial uses, although in recent years Italy has made distinct progress."

Dr. Charles A. Doremus has retired from his duties as Professor of Chemistry at the College of the City of New York.

The Manhattan Transit Company, which has the charter for auto buses on the streets of New York, is building twenty of the machines which it expects to have running before spring.

Secretary Morton has employed Stone & Webster of Boston to report on the conditions surrounding the manufacture of power at the various navy yards of the country with a view to obtaining an unprejudiced and competent opinion as to the merit of the proposed consolidation of the navy yard power plants.

The International Engineering Congress is now in session in St. Louis and will not adjourn until Saturday. Two important papers will be read before the electrical section by James G. White and Alexander Siemens, on "The Substitution of Electricity for Steam as a Motive Power," and by L. B. Stillwell on "Electric Power-Generating Stations and Transmission."

Vice-President E. P. Bryan of the Interborough Rapid Transit Company of this city was last week relieved of the duties of general manager, the office of general superintendent held by Frank Hedley was abolished, and Mr. Hedley was made general manager at a salary of $25,000 a year.

Sir William Ramsey has informed his friends that he will sail to-day (Wednesday) from New York for England.

The water board of St. Paul, Minn., is to purchase an electrical thawing device for keeping the house connections open during the winter.

The French Government is about to erect the first wireless telegraph station on an island off the westernmost point of France. This will be used to communicate with incoming and outgoing transatlantic steamers.

MEDIUM-SPAN LINE CONSTRUCTION.*

BY C. A. COPELAND.

In the past it has been the chief desire of electrical companies to get to the customer with some sort of a line and obtain a swift revenue, while the engineer has not considered it worth his while to spend more than a wisp of his time on line work. The result has been that more than 75 per cent. of the troubles experienced in the distribution of power, both as to number and cost, have occurred outside the central and sub-stations. The major part of the cost of these troubles has been due to lack of confidence in electricity as a power fund and convenience which does not always show on the books. These remarks apply as well to telephone and telegraph lines and distributing systems as those for light and power. Not only have lines been excessively troublesome, but they have cost too much. With a view to eliminating both of these faults on cross-country lines, the Edison Electric Company of Los Angeles has been experimenting on several special methods of distributing-system design. The one immediately concerned may be termed medium-span cross-country construction.

The ordinary length of spans, say from 120 feet to 140 feet, which have been used for the lines, have evidently been transplanted from early days and from localities where snow and ice load the wires to their breaking point even with 100 feet spans. The conditions obtaining around a newly contemplated line should be as carefully studied as those surrounding the hydraulic and central station installations. Transplanted engineering may not always thrive in new soil. The conditions encountered in the valley districts of Southern California are: (1) No snow and ice; (2) a temperature ranging from 20 degrees at night in winter to 140 degrees in the sun in the summer (that is, a wire will become that hot); (3) occasional severe dry north summer winds which blow hay and mustard stalks upon the lines; (4) frequent interference with lines by wild cats, buzzards, sandhill cranes, mudhens and owls—especially the May and June owls; (5) numerous and almost unavoidable hedges of eucalyptus trees from 50 feet to 150 feet tall, which, with the assistance of winds, shed twigs and long shreds of bark on to the lines; (6) rapid decay of poles, some rotting off in four years, while the average life is eight; (7) high cost of poles, the cheapest being cedar, and in 35 feet and 40 feet lengths, costing from $5 to $10 in the yard.

*Paper read before the Pacific Coast Electric Transmission Association, Monterey, Cal.

Experience with bare aluminum cable suggested to the writer that stranded copper cables might be used in long span construction. It was proposed to take good stocky 40 feet cedar poles, space them 225 feet apart, space the wires 45 inches apart, and employ a sag of from 15 inches to 24 inches, depending on the installation temperature. It was designed that a three-phase construction for a voltage as high as 40,000, with one or two circuits of Nos. 3, 4, 5 and 6 cable with single cross arms, and Nos. 0, 1 and 2 with double cross arms should be used. The longest continuous long-span work previously employed was in Europe on the Paderno–Milan transmission, with solid No. 1 wire and steel lattice work poles spaced 190 feet. In the light of subsequent experience it would seem that if stranded wire had been used the poles could have been made a little heavier and taller and spaced twice as far apart. On the Vizzola–Ticino–Milan transmission, also, steel latticed poles about the same distance apart had been used.

These ideas were received with temerity. It was argued that in case a wire broke, so and so would happen. But if stranded and carefully installed they will not break. It was also argued that in case the poles rotted the line would be weakened more than if the poles were nearer together. But it would seem that a line should be kept in good repair, whether the poles were many or few, either by letting down 5 feet or stubbing. An engineer would not buy a boiler with more tubes in it than necessary, and let them get in poor repair because there were enough tubes left to keep the boiler safe.

It was argued that in case the top of a pole burned off at the brace, as sometimes happens on the 30,000 volt line, No. 6 wire would not support the weight on a 450 feet span. Accordingly, two experimental spans of 250 feet were constructed and strung with bare solid "second-hand" medium hard-drawn copper, and while it is not necessary to go into great detail in regard to this test, it is sufficient to say that it was amazing the abuse these wires stood before breaking. No. 6 aluminum cable was also tested, and stretched so far before breaking that it also deserves much respect. The stretching factor of safety of copper wire is scarcely appreciated by engineers, and after these tests the writer very nearly recommended solid wire for 225 feet spans. In fact, a European steel pole line employs 246 feet spans with solid No. 2 and 00 wires on 40 feet poles.

The writer knows of no case where a good solid medium hard-drawn wire has broken without a good apparent excuse, such as a burn-off. He has known of such breaks on poor wire which did not come up to the company's standard specifications. The moral is that, with rigid specifications followed by tests, much longer spans with solid copper can be made. We have 8 miles of No. 5 line with 150 feet spans, with wire which did not stand a very good test, which has given no trouble.

Stranded copper, however, is superior for 225 feet span work in that: (1) A careless lineman in nicking it reduces its strength less than by nicking a solid wire. A test was made on one cable, during which one strand broke at a 5 inch sag on 225 feet, but the cable still stood up. (2) Its strength is more uniform throughout its length, and therefore a less sag can be safely depended upon. (3) It has a higher strength per square inch because the wires are smaller and are individually stronger. (4) It has a spring effect or untwisting factor of safety. (5) It has a higher elastic limit. It is believed (but not proven) that stranded copper will not burn off so easily as solid wire on account of its radiating facilities, and because one or two strands will hold the cable intact if the other strands burn off. It costs from 8 to 12 per cent. more than solid wire of the same conductivity.

Following out these considerations, 4 miles of experimental line were installed in two sections, one in the Lytle Creek district, near San Bernardino, 2 miles long, of three-strand No. 5 copper, and the other at Anaheim, of No. 5 seven-strand copper. In the former a 500 feet span was inserted. Otherwise the constructions are identical, and have stood over a year and have passed through the most severe wind storms known in this section for many years. The poles and corner pins now stand perfectly straight, although another new line near by with 140 feet spans and six wires leans badly from the wind. These medium-span lines were, of course, installed with care and by trusty men who have been with the company for several years.

The top cross-arm (Fig. 1), with three cables only; No. 13 Locke oak pins, with a bolt center; 2¼ inch washers under each pin and nut; ordinary deep-groove double-porcelain insulators (selected), with a piece of copper wire netting under each to prevent the burning of pins; three strands of No. 17 medium hard-drawn copper wires twisted together for a telephone cable, which was strung on transposition glass insulators and No. 13 Locke pins, and transposed every third pole, were some of the features of construction.

Mogul paint was used on all threads, nuts and points of contact of iron and wood and in the gains, galvanized iron wrapped around the poles under the guy wires. The strand was not allowed to touch the ground, and was spliced by twisting with an annealed and flattened copper tube. A double lock tie of No. 8 wire was used with a wood-covered tie wrench; no pliers or come-alongs were allowed on the job. All kinks were eliminated with a splice.

They are both 10,000-volt lines, and the advisability of using deep-groove double-petticoat insulators will be questioned. Seven years' actual service, however, has shown them just as good as any. In fact, there are indications that they are better. They seem to discharge the line without burning the pins. Mechanically speaking, they are superior because the wire is let down closer to the cross-arm. They should, however, be used with caution, because the conditions on other systems and localities might not be similar.

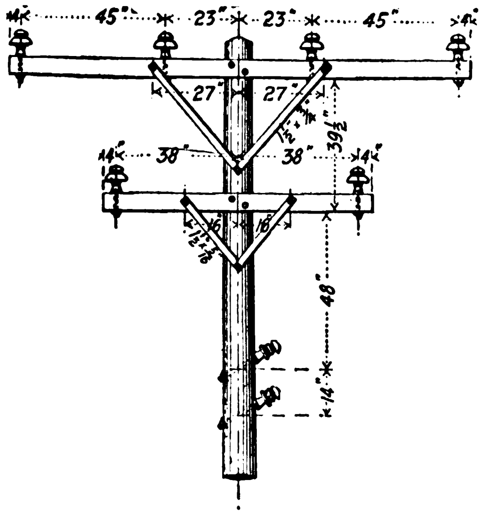


FIG. 1.
Experimental Medium Span Construction. Edison Electric Company of Los Angeles, Cal.

The following are representative specifications used for stranded copper cables:

1. This copper cable is to be used for long-span work with 225 to 300 feet span. The cable must be bare and composed of seven medium hard-drawn copper wires. The cable must have a resistance of 0.3944 ohm per 1,000 feet—that is, equivalent to No. 6 of 100 per cent. Matthiessen's standard conductivity.

2. The cable must have a lay not greater than 4 inches—that is, one turn of each wire around the cable in 4 inches of its length.

3. The cables are to be furnished in such lengths that no splicing of individual strands is necessary. When the length of one wire in the strand runs out, the whole cable is to be cut at this point by the manufacturer, to be eventually spliced by means of copper sleeves when the line is constructed.

4. The cable must be pulled through a non-corroding grease bath before being reeled, to prevent the chafing of the cable against itself in shipment. Paraffin is suggested.

The strength of the cable must be such that it can be pulled up to a 5 inch sag on a 225 feet span (to be strung with a 15 inch to 24 inch sag on the actual line). In accepting the cable, seven samples will be tested from various portions of the shipment and five must stand a 5 inch sag, while two will be allowed to break at this sag, 25 samples of individual strands will be taken from the shipment and given a twisting test, twisted six times on and off its own diameter. In such a test the strands must show absolute uniformity of material and drawing. The surface of these individual strands must present a good luster and be free from seams, drawing nicks and silvers.

5. Bids are solicited on this cable, manufacturers to specify weight and price per foot.

The writer lays great stress on the old twisting test, as it is found to be an extremely good gauge of uniformity of the product. It is not considered advisable to have a wire of 70,000 lbs., 50,000 lbs., 30,000 lbs., 65,000 lbs., 40,000 lbs. per square inch ultimate strength at various points along its length. It is more advisable to have it uniformly from 45,000 to 50,000 lbs. The twisting test determines this, and in a rough way the tensile strength.

Tests on the seven-strand Anaheim cable and the three-strand telephone cable showed an ultimate strength of 59,500 lbs. per square inch, corresponding to a 5 inch sag of 225 feet. An actual span was used for the test and remarkably uniform results were obtained, the cable breaking at just 5 inches sag each time. At 5½ inch sag the cable had stretched 11 inches in 225 feet, and had a permanent set of 4.6 inches. Subsequent cables have broken uniformly at 63,250 lbs. per square inch.

After all, the important factor of this work is, has the engineer "done for a dollar what any fool can do for two?" which brings us up to a consideration of comparative costs. At the time when this matter was first being discussed, 5¼ miles of 30,000 volt line was built from Mentone to the new Mill Creek No. 3 power house. The ground was exceedingly rocky, which made the cost of digging holes from $1.50 to $3.30 each, and the cost of stringing and hauling very great, with two three-phase circuits of No. 4 wire, and 125 feet and 120 feet spans. A saving of 16 per cent. could have been effected by 225 feet medium-span construction with cables, and the line would have been safer, because the wires would have been 45 inches apart instead of 36 inches. With No. 6 the saving would have been 21 per cent. while with No. 3 wire, which is about the practical limit of this kind of work, a saving of 11 per cent. would have been obtained.

There is now being constructed 9½ miles or more of medium-span line in Lytle Creek, near San Bernardino, directly in the path of the severe north winds, of the 40 feet wood pole, 225 feet span construction, with deep groove double porcelain insulators on 10,000 volts. Half of it is to be strung with No. 5 and half with No. 6 cables, and a saving of 24¼ and 26½ per cent. will be effected. This is a single-circuit line prepared for drawing in another one eventually. In single circuit line, where wire is a smaller percentage of cost, the greatest percentage of saving by the longer spans is secured.

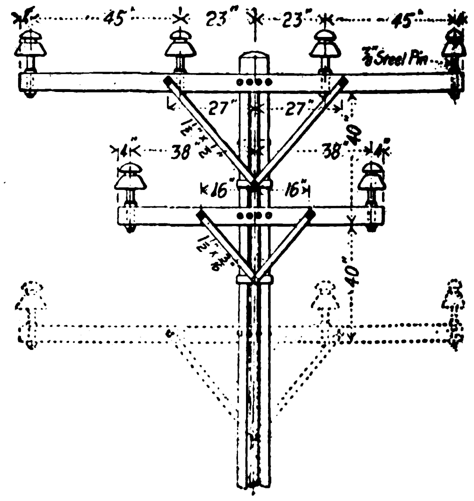


FIG. 2.
Steel Pole Construction for 300 Feet Span.

The company is now building 14 miles of line from Los Angeles to Inglewood to connect the old United Electric, Gas & Power Company's beach towns, 38 miles, 17,300-volt transmission system, which the Edison Electric Company has lately acquired, with the 30,000 volt Edison system. This is composed of six No. 4 seven-strand copper power wires (see Fig. 2) strung on a new special porcelain insulator and the three-strand telephone cable mentioned above; 30,000 volts will be impresssd on the line. The 40 feet poles are of steel and placed 300 feet apart. The cross arms are of wood because of the danger of birds burning wires off by grounding, but special iron pins have been designed, and all pins are to be grounded together by a fine wire underneath the cross arm to prevent burning of the wooden parts. The soil is

mostly sand, and a cylinder of cement, 5 feet deep, is used to set the poles in. Even then the cost is only $48 per mile more than a wood pole line with 125 feet spans, because wood poles would have to be taller than 40 feet. If, however, 45 feet wood poles and 225 feet spans had been used, the cost would mean an advantage of 20 per cent. over an ordinary 125 feet span cedar pole line.

The cost of a 40 feet tripartite pole made by the Franklin Rolling Mill of Franklin, Pa., in this steel construction, is about $35 f.o.b. Los Angeles, as against $9 for a 45 feet cedar pole, so that the above figures are rather surprising. The excess cost of the 300 feet span steel line over the 225 feet span wood line is what the company pays in first cost to prevent depreciation. The advantage is gained that, should the line ever be changed or moved, the poles would be as good as new for a new place. Ordinarily, in such cases, even though the poles are not rotted badly, they are not worth placing again without sawing off. This principle, which is often lost sight of, is especially applicable to city distributing systems. It will be observed that this construction is especially advisable on lines with small wires—i. e., telegraph, telephone and power lines of Nos. 3, 4, 5 and 6 wire.

The percentage saving on single-circuit lines is especially great, and the percentage saving is greater the greater the cost of poles and digging holes, and particularly where the poles must be hauled a great distance and when the company must provide tents and eating facilities along the line in building. On high voltage lines, where the insulators cost considerably, the saving is very patent.

Only in rare instances does the 15 to 20 inches sag instead of the 8 inches make any difference in the height of poles. Private telephone lines should be at least 50 feet below the lowest power cross-arm, and at least 8 feet above the tallest trees. which usually dictates the height of poles. These methods may become important in case a double-pole line is considered advisable where small amounts of power are transmitted at high pressure or small distances. The question of the preservation of poles from decay is of some importance in this discussion. Granted that a good, cheap, practical method of preserving poles at 75 cents to $1 per pole can be found—and we are making rapid progress in this direction—the saving by using this medium-span construction is greater than cited above, and entirely removes the question of the greater weakening of the line by the decaying of poles in the longer-span construction.

In conclusion, it may be said that by effecting a saving of from 10 to 30 per cent in lines ordinarily costing from $700 to $1,700 per mile, and having from 3 to 12 of the smaller sizes of wire, a slight advance has been made in the art in the field of light construction, where the cost of poles, freight and haulage is great, especially as they are better and safer lines than are ordinarily built with more cost; or, stating it another way, they are as cheap as the cheapest allowable lines and twice as safe and free from trouble and danger.

ON LARGE BULB INCANDESCENT ELECTRIC LAMPS AS SECONDARY STANDARDS OF LIGHT.*

BY J. A. FLEMING, M.A., D.SC., F.R.S.

(Concluded from page 179.)

As an instance of the utility of these lamps in the comparison of flame standards, it may be mentioned that the author recently sent three of these large-bulb standard lamps to Berlin by his assistant, Mr. W. C. Clinton, and they were photometrically measured in the Physikalisch Technische Reichsanstalt at Charlottenburg. The same lamps were subsequently taken to the National Physical Laboratory, Bushy House, Teddington, and measured independently. In Berlin the standard of comparison was a Hefner lamp, and at Bushy House it was a Harcourt 10 cp. pentane lamp. The ratios of the certified readings gives us the value of the Hefner unit in mean British candles, and it is close to the value usually assumed. These three lamps are called Pender IV, Pender VI and Pender X respectively. The results are tabulated below:

Lamp mark.	Value of the illuminating power in Hefner units assigned at the Reichsanstalt	Value of illuminating power in British candles assigned at the National Phys. Lab.	Value of the Hefner unit in British candles.
	H.U.	C.P.	
Pender IV	15.1	13.41	0.888
Pender VI	12.6	11.12	0.883
Pender X.	15.9	14.07	0.885

The mean value of the ratio is 0.885. The lamps were all measured at 96 volts, and the current values obtained at the Reichsanstalt agreed with those obtained at Bushy House within 1 part in 1,000. The real value of this ratio, is, however, closer to 0.88, because it appears that the measurements at the Reichsanstalt were really made at a voltage of 95.9, on the supposition that this was equivalent to 96 volts in England, assuming that the value of the Clark cell was taken here in England at 1.434 volts, whilst at Berlin it is taken as 1.4328 volts, both at 15 deg. C. This, however, is not the case, hence if the voltage employed in Berlin had been increased by 1 part in 959, this would have involved an increase in the light of the lamp equal to about 5 parts in 900, and, therefore, a decrease in the ratio of the Hefner unit to the British candle as obtained from the given observations in the ratio about 5 parts in 900, and this would decrease, therefore, the ratio in the fourth column of the table to very nearly 0.88, instead of 0.885. Hence we may take it that the above fraction (0.88) represents very nearly the ratio between the Hefner unit as employed in Berlin and the mean British candle as employed in London as a standard of illumination.

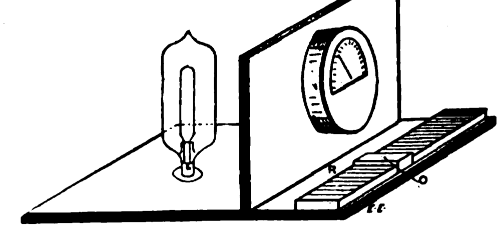


Fig. 2.

In connection with these large bulb lamps, the author has arranged a simple apparatus, consisting of a large bulb lamp, a rheostat, and an ammeter, the range of which comprises merely the ordinary lamp currents. The ammeter is, however, not graduated to read amperes, but graduated to read candle power, so that if the rheostat is adjusted to make the ammeter needle point to any part of the scale, that scale reading would at once, without further calculation, give the candle power of the lamp in the normal direction. Although this apparatus is not accurate enough for laboratory purposes, yet for workshop or generating station purposes it is a convenient arrangement for obtaining a fairly accurate standard of light without the complications involved with the use of the potentiometer. The arrangement of the apparatus is shown in Fig. 2.

In conclusion, the author has to record his thanks to Mr. W. C. Clinton, B.Sc., for much laborious and careful work during many years in making numerous photometric comparisons, but the experience so gained has every year tended to confirm the opinion that these large-bulb incandescents, when used as described, form a most convenient and constant standard of light.

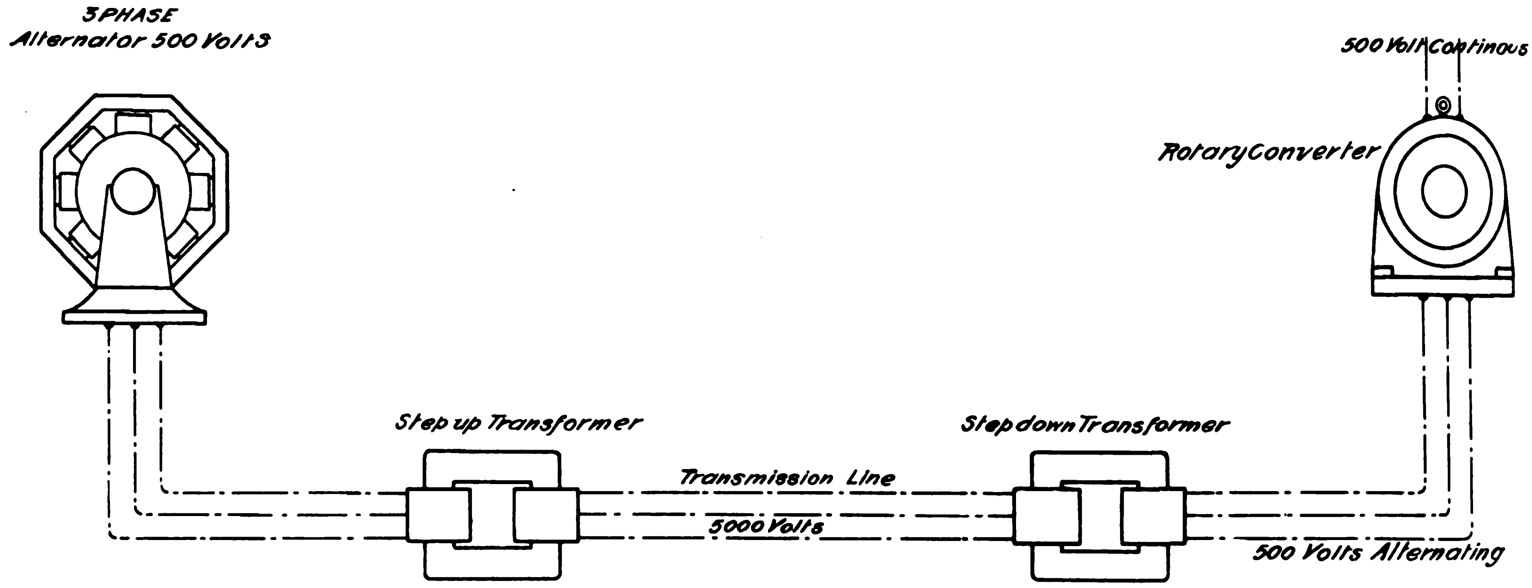
*Paper read before the British Association at Cambridge, Eng., Aug. 22, 1904.

WIRING LEAFLETS.

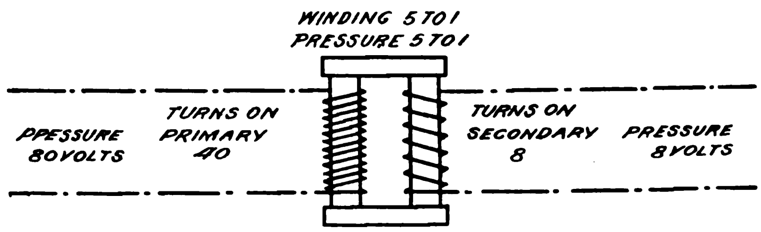
BY NEWTON HARRISON, E. E.

(*Concluded.*)

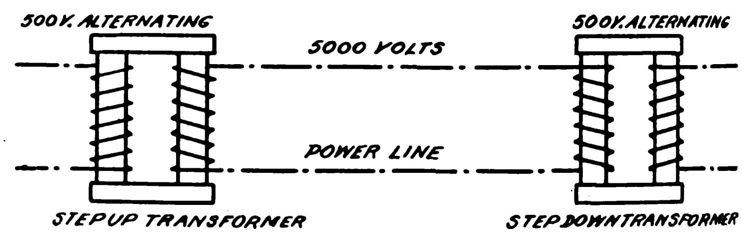
Rotaries in Power Transmission.—In the accompanying sketch is shown the wiring plan of a power transmission plant with rotary converters in circuit performing the function for which they were designed, viz., the transformation of alternating into continuous current at the receiving end, and the transformation of low pressure alternating into high pressure alternating by means of alternating current transformers at the transmitting end. The alternating current transformer consists of a magnetic circuit embracing two coils, a high and low pressure coil. By means of this device the pressure and amperes are converted either higher or lower, the total watts with the exception of those naturally lost during the process remaining the same. The transformers are termed step-up transformers and step-down transformers according to the purpose involved in their design.



Elements of a Power Transmission Plant.



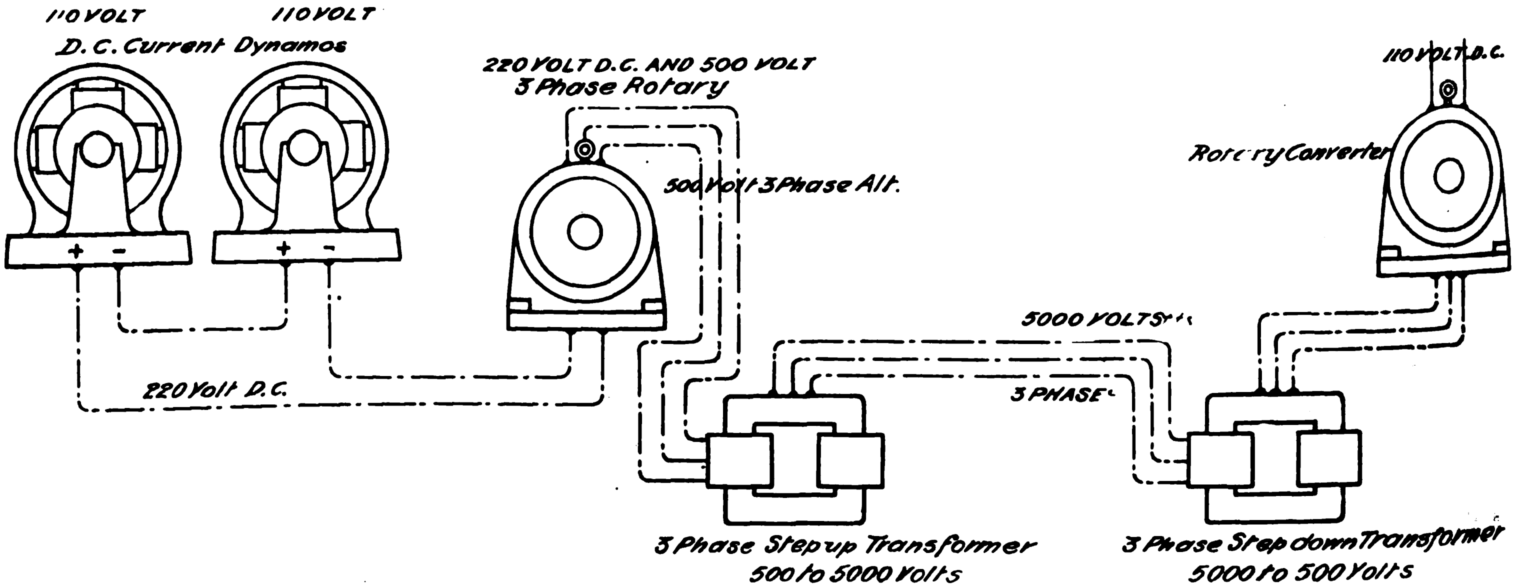
Principle of Transformer Winding.



Step-up and Step-down Transformer in Service.

The windings of transformers are in the same proportion as the electromotive forces they generate. That is to say, if the primary winding receives 40 volts and has 40 turns the secondary winding to give 8 volts must have 8 turns. This gives a ratio of 5 to 1, and is termed the "ratio of transformation."

Rotaries in Electric Light Stations.—The application of rotaries, as previously stated, has, in a measure, solved the problem of power distribution with reference to the use of sub-stations and the degree of assistance one large central station can give to other smaller stations in various parts of the city supplying the same circuits. The transformer and the rotary have been the direct means of bringing about a revolution in lighting methods in direct current stations.



Method of Distributing Power to Sub-stations as Employed by the Edison Company.

In the illustration is shown the machinery employed and way in which rotaries play their part in regard to the generation of direct current and its subsequent distribution to a sub-station, if it repre-

sents a surplus of power or if the distant station is approaching a point of overload. In either case the system is of incalcuable benefit as regards elasticity and economy. By adopting this system on a large scale the necessity for any other than a large central station disappears. It becomes the center or nucleus of a number of sub-stations, which distribute the electricity after receiving it, through the medium of rotaries, to the outlying circuits in their vicinity.

The Two-Phase System—As this system relates to power transmission and electric lighting it must be included as a type which practice has shown to be of leading importance. By means of two or three-phase currents, it is possible to utilize self-starting alternating current motors. Formerly, the alternating current motor was started by some external means, such as an engine or a direct current motor, or a means was found of developing in a simple alternating current, called a single phase current, the equivalent of two phases, by which an alternating current motor became self-starting. The two and three-phase current, however, is generated and utilized because it may be used not only for electric lighting but for motors without any accessories in the way of starting devices. Two and three-phase motors are self-starting. The general plan of the connections of a two-phase alternator to the four lines by which its power is transmitted, as given by the Westinghouse Company, are shown in the illustration. The auxiliary field is obtained by transforming the alternating into direct current by means of a commutator and sending this current into the additional field winding designated.

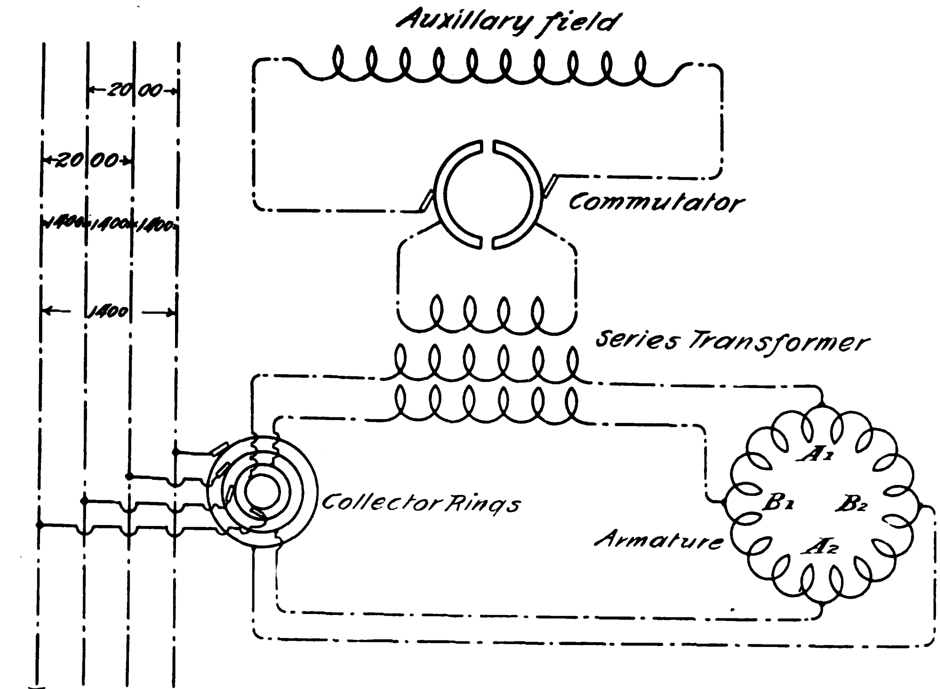


Diagram of Connections for Two-Phase Alternators.

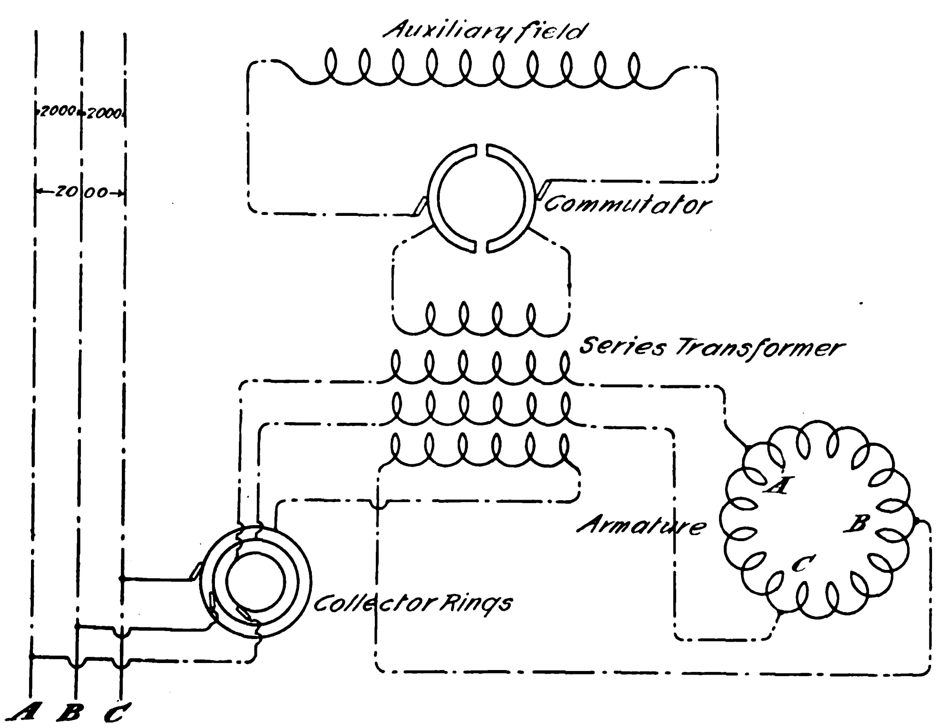


Diagram of Connections for Three-Phase Alternators

The Three-Phase System.—The plan of connections relating to this system are also shown with auxiliary field connections as in the two-phase system. In addition to the ordinary winding the auxiliary winding is employed, giving rise to the expression "composite winding." The additional coil of the series transformer receives a low potential current proportional to the main current. This current when rectified acts upon the field of the alternator through the auxiliary winding.

It depends upon whether the main purpose is electric lighting with motor circuits incidental, or whether it is entirely a power supply for motors as to the wiring at the switchboard for a two-phase system. A choice may be made of two methods:

First—All four-wire circuits if motors are the principle purpose.

Second—All three-wire circuits if lighting is the main object.

In the second case the three wires, A_1, B_1 and A_2 or B_1, A_2 and B_2 are tapped. Transformers are connected and the pressure lowered to the point required.

Panel Boards.—In general house wiring the circuits are all led to a given point on one floor if the floor is small, or, if it is large, several of these points are employed at which panel boards are installed. Panel boards are merely slate boards on which small switches are systematically arranged for the control of the branch circuits on the floor and on which the fuses controlling those branches are mounted.

They are built for two and three-wire mains with branches on both sides of the mains. In the illustrations are shown two panel boards as described, one for a two-wire system with two wire branches, the other for a three-wire system with two wire branches. In many cases a main switch is also mounted so as to give control to the entire floor or section of the floor as the case may be. In many respects these panels might be aptly termed secondary switchboards as they control the circuits at the points of distribution.

UNDERWRITERS' REQUIREMENTS REGARDING SWITCHBOARDS AND PANEL BOARDS.

Switchboard:

a. Must be made of non-combustible

non-absorptive insulating material, such as marble or slate.

b. Must be kept free from moisture, and must be located so as to be accessible from all sides.

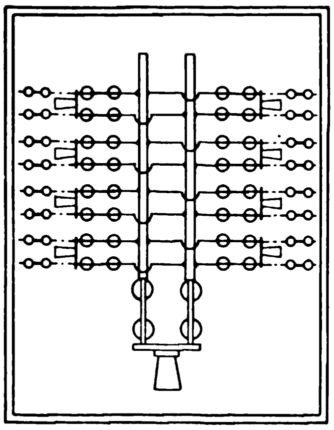
c. Must have a main switch, main cut-out and ammeter for each generator. Must also have a voltmeter and a ground detector.

d. Must have a cut-out and a switch for each side of each circuit leading from board.

Tablet and Panel Boards:

The following minimum distance between bare live metal parts (bus-bars, etc.) must be maintained:

Between parts of opposite polarity, except at switches and link fuses:



Panel Board for Two-Wire System.

When mounted on the same surface—0–125 volts, ¾ inch; 126–250 volts, 1¼ inch. When held free in the air—0–125 volts, ½ inch; 126–250 volts, ¾ inch.

Between parts of the same polarity:

At link fuses—0–125 volts, ½ inch; 126–250 volts, ¾ inch.

At switches or inclosed fuses, parts of the same polarity may be placed as close together as convenience in handling will allow.

It should be noted that the above distances are the *minimum* allowable, and it is urged that greater distances be adopted wherever the conditions will permit.

The spacings given first apply to the branch conductors where inclosed fuses are used.

The spacings given second apply to the distance between the raised main bars, and between these bars and the branch bars over which they pass.

The spacings given third are intended to prevent the melting of a link fuse by the blowing of an adjacent fuse of the same polarity.

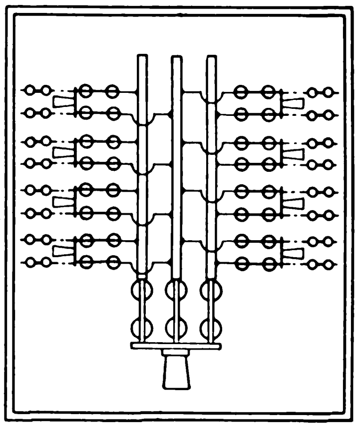
For further and more detailed reference to the requirements of the National Board of Fire Underwriters the National Electrical Code must be consulted. A copy of this may be obtained from the Fire Underwriters of any large city.

ENGLISH ELECTRIC TRAMWAY QUESTIONS.

(From our London Correspondent.)

British electric tramway officials are very much engaged at the present time with the provision of top-covers for double-decked tramcars. When the idea of coverings for two-story cars was first mooted a year or two ago it was welcomed with open arms by some engineers who were haunted continually by the sight of cars filled to overflowing "inside" and empty outside because of bad weather conditions.

The exceptionally wet weather during the summer months of both 1902 and 1903 quite naturally made the tramway man-



Panel Board for Three-Wire System.

ager eager to adopt any reasonable means for preventing serious falling off in traffic, and the top-cover was consequently applied by some who perhaps would not have adopted it had the weather been normal. But whatever were the influences weighing with the owners and operators of electric surface lines at that time, it has been proved in quite a number of places that the expenditure was quite justified and that it has undoubtedly promoted traffic. It is true that some criticism has been leveled at the proposal, both on the ground of ugly appearance and unhealthfulness, but whether this criticism be correct or not, it is found that travelers do not fail to express their appreciation of the greater convenience.

British electric lines look to the Glasgow Corporation tramway system a good deal for a leading example. What the Glasgow municipality does all the smaller town authorities regard as absolutely correct—"the King can do no wrong" best illustrates their attitude in this connection—and worthy of emulation. That is the general rule, but of course it has its exceptions, and this top-cover question is one of them, for Glasgow had no desire to step too quickly in the matter, preferring rather to wait awhile experimenting with different designs, and watching closely to see whether the game was worth the candle. And now it, too, has made up its mind that the adoption of outer covers is going to "double the carrying capacity of the cars." The work of covering 100 out of the 700 cars in the service is now being proceeded with. The action of Glasgow will, it is safe to say, be closely followed in many places where there has been hesitation, or only very limited experiment, up to the present.

A POWERFUL ELECTRIC CRANE.

Herr R. Kann, in a summary of modern crane work which appeared recently in the "Zeitschrift fur Elektrotechnik," gives the following interesting data of a powerful crane erected in the autumn of last year at Lloyd's arsenal at Trieste. It is situated alongside the dock, and is chiefly intended for transporting completely assembled boilers and machinery to and from large warships and mercantile vessels. Arrangements have also been made for conveying lighter loads at higher speeds. A tower of girder work forms the bearing for the moveable portion of the crane, which takes the form of a T. The principal dimensions of the crane are: Height of the crane above the ground 112 feet; length of track 185 feet; maximum radius of action for a load of 120 tons, 65½ feet, and for loads not exceeding 35 tons, 100 feet. There are two crabs, one for a normal load of 120 tons, the other for 35 tons. After erection these were tested with 170 and 50 tons respectively.

Arrangements have been made in connection with the smaller crab, so that the gearing of the latter may be changed by pulling a rope from the motorman's cab. This allows of loads under 10 tons being hoisted exceptionally quickly. The various hoisting and traveling speeds are: Hoisting speed of large crab, 1.8 feet per minute; traveling speed of large crab, 27.8 feet per minute; hoisting speed of small crab for loads less than 10 tons, 26.2 feet per minute, and for loads between 10 and 35 tons, 9.8 feet per minute; traveling speed of small crab, 65 feet per minute. The crane may be slewed completely round in six minutes. All motions are performed by 110-volt series motors, of which the following have been provided: On the large crab there are two 25 hp. to 30 hp. hoisting motors, and one motor of the same capacity for traveling purposes. On the small crab the motor equipment consists of one 35 hp. motor for hoisting and one 10 hp. motor for traveling. The slewing is done by one 35 hp. motor.

In addition to the two crabs mentioned,

there is also a small wagon, carrying the balance weight and running on the same rails. By suitably disposing the crabs and the balance weight on the track, the crane may always be well balanced. In order to avoid excessive stresses due to strong winds, the movable part of the crane is allowed—when not in use—to turn with the wind like a weather cock. The weight of iron used in the construction of this crane approximates 250 tons, the total maximum weight which the foundation of the crane will normally have to carry being not far short of 400 tons. Slewing is performed by the 35 hp. motor mentioned, driving through a multiple gearing on to a large spur wheel cast in one piece, and having a diameter of 13 feet, and a weight of more than 12 tons.

Current is conveyed from the iron-armored cables to the crane itself by means of two slip-rings. From the slip-rings the current is transmitted to the motorman's cab situated underneath the center of the track. All controlling apparatus are concentrated here, and cables emanate from this cab to the various motors. In order to obviate confusion, the levers of the hoisting motors are made to work in a vertical plane and those of the traveling motors in a horizontal plane.

Arrangements are made so that the current is automatically interrupted should the crab travel too near to the end of its run, but it is still possible to operate the crab backwards, and when this has been done the interrupted circuit is closed again, so that both forward and backward movements are possible.—"Electrician," London.

ON INSULATION.*

It may be taken for granted that testing the insulation of an electrical machine after completion, without any previous satisfactory knowledge of the insulating materials used in its manufacture, is far from the correct thing to do. If, then, we are to choose between the various insulating materials on the market (each of which may be good for a particular purpose), it becomes essential to institute some preliminary tests. As to what should be the nature of these tests, it would be profitable to first consider what the insulation has to do, and under what conditions. These points will determine the nature of the tests it will be profitable to make.

It will be beneficial here to note some of the conditions which have to be fulfilled by a good insulator, though it may not be absolutely necessary that one particular insulator should meet every possible condition. These conditions may be broadly divided into two classes—viz., those necessary for convenient and cheap manufacture, and those essential to the longevity or commercial efficiency of the machine.

*From the "Electrical Engineer," London.

Taking, first, "paints or varnishes," we find the following features desirable, if not absolutely essential: (1) they should be quick drying, and yet should not lead to great waste owing to the drying up of the solvent; (2) they should have considerable elasticity and strength; (3) have a high melting point, and should not lose their insulating properties or char with possible rises of temperature in practical use; (4) should not chemically affect the copper conductors; (5) must be waterproof and unaffected by oils, acids, and, as sometimes specified, salt water; (6) last, but not least, should be good insulators.

Secondly, with regard to insulating fibres, papers, and tapes, we know that some depend on the nature of the material for their insulating properties, whilst in others this is merely a medium for carrying an insulating "varnish or paint," and it is on this that the strength of the insulator, as such, depends. This latter class, which also includes a certain variety of tapes, should, as far as the insulating medium is concerned, with which they are impregnated, fulfill the conditions enumerated above for paints and varnishes. Regarding fibers and papers in their "natural" state—i. e., not impregnated with an insulating medium—they might be approved of if they meet the following conditions: (1) they should be tough, yet pliable; (2) should not suffer excessively as insulators should they be creased; (3) they should, as far as it is possible to make them, be non-hygroscopic; (4) should be able to stand all temperatures experienced in practice without charring or reducing their insulating properties; (5) should have high insulation per mil of thickness, except where their mechanical strength is the principal consideration. It will be obvious from the varied nature of insulating materials, and also from the fact that no one material meets all conditions, that a choice has to be made of such as will best suit the varying conditions of service, both mechanically and electrically. With careful attention to this point considerable reduction in the cost of insulating materials may be effected in the manufacture of various electrical apparatus, though the cheapest insulation is not always the best.

Returning to the subject of varnishes and paints, let us look at the first of the properties required—viz., "quick drying." It will be obvious to anyone acquainted with shop methods the great saving in time and the increased output that can be obtained from a given drying stove, the more "quick drying" the insulating medium is. With this object in view resource has been made to shellac, copal and resin varnishes, using alcohol as a solvent. This would not be objectionable but for the fact that when the spirit (and also the water it carries) has been dried out, the resulting solid is too brittle. This solid under vibration or due to expansion and contraction, as the winding heats up and cools down, is in time reduced to a powder, and is then, of course, useless as an insulator. Should it be a revolving portion of a machine that is insulated with these varnishes, then centrifugal force will assist in the destruction of the insulation. Oil "varnishes" are not "quick drying" unless an objectionable amount of "dryer" is introduced. A considerable amount of waste occurs where the varnish has to be painted on coils such as are inconvenient to dip. Further, all tanks used in dipping coils should be provided with covers when not in use. Even while in use attention has to be paid to the consistency of the material owing to constant evaporation, and "thinners" have to be added, as when used too thick more insulation is added than is required, leading to needless expense.

2. The second property claimed is that of elasticity and strength. From this point of view, all mixtures, as distinct from chemical compounds, should be avoided. They are objectionable because of separation through settling. Should this be overcome by frequent stirring it is only temporary, as separation can take place after application. These mixtures are often brittle when thoroughly dry, and this considerably impairs their use. The American asphaltums, or, as they are rechristened here, varnishes, are satisfactory at first as regards elasticity, but in time become brittle.

3. If high melting point is forthcoming, coils or armatures may be satisfactorily baked. Armatures, however, running at high peripheral speeds, especially turbine armatures, throw off the varnish in which they have been dipped at comparatively low temperatures, as the high centrifugal force assists in this work. This is, of course, a great disadvantage, covering as it does the field winding and poles with a discoloring varnish. It may be noted here what temperatures may be expected

under working conditions. The writer knows of one or two electric lighting stations where the temperature is not infrequently about 100 deg. F., and with the usual 70 deg. F. rise of temperature stipulated in most specifications, we get 170 deg. F. as the final temperature. This, it should be noted, is only at points convenient of reaching, and consequently internal parts of the windings will be considerably higher. It is certain, therefore, that insulating materials should not melt or have their insulating properties deteriorated under a temperature of at least 212 deg. F. Even this will probably leave no margin. Insulating materials should be tested throughout the working limits of temperature, as some lose their previously high insulating properties when the temperature is raised to the working limit, while the insulation in some cases chars or carbonizes. This is a very important point, as many engineers insist that pressure tests on plants must be made immediately after a lengthy full-load run, and sometimes an additional run of two hours on 20 or 30 per cent. overload. The machine will, of course, be still warm and most likely warmer than at any time on load, as the cooling effect of the revolving parts has then ceased.

4. Affecting the copper winding chemically applies more particularly to varnishes, but as insulating materials are generally secret mixtures, it is not safe to say that all paints are free from this fault. If, however, care is taken to neutralize any acids, such as would attack copper and gives us the green deposit of copper sulphate, this fault is done away with. The moisture in the cotton covering of wires, not dried out before varnishing, assists in this chemical action which destroys the cotton covering, and thus leads to short-circuiting of the turns. It would be as well to mention here that cotton covering is much to be preferred to paper, which is readily cut on the edges of flat strip copper. Cotton covering should never be single, and if to be roughly handled should be braided.

5. The material should be impervious to moisture, unaffected by oils, acids, and salt water. It is, of course, well known that water is an undesirable attendant of insulation, and, therefore, there is no need to labor this point beyond mentioning the specially adverse conditions to which some outside work is subjected, as for instance, traction motors of all descriptions, motors for small tools in shipyards, etc. Insulation should certainly not wash off within a reasonable time. Regarding oils, many machines are subjected to trouble from this cause; motors from faulty bearings, etc., and generators from this cause and, where placed between engine standards, from splashing of oil from the engine. Acids are detrimental to insulation, and more than one machine has had to be rewound owing to being subjected to the acid fumes from battery rooms. Salt water has been added by engineers in cases of exposed stations near the coast, especially where the voltage generated is high, though in the case of low voltage it would only be a question of time if the insulation was not impervious to salt water.

6. The material should be a good insulator. This goes without saying, and if this is not forthcoming, the properties previously enumerated are of no account whatever. A thickness of insulation of .003 inch thickness should stand at least 2,000 volts alternating R.M.S. volts. It is well to notice that fibrous materials dipped in insulating compound rarely add their full breakdown strength to that of the varnish, and it is well to look upon the material as only a medium of applying the insulating varnish.

Turning now to fibrous materials (including papers and tapes), it will be obvious that where the paper, tape, etc., is used merely as a medium for carrying the insulating varnish, that that insulator should remain intact, that it should not crack on handling the tapes, etc.; consequently those insulators having the property of elasticity are invaluable for this use.

Considering the fibres in what we have called their "natural" state, the first property mentioned was pliability. This is essential from a manufacturing standpoint. A pliable material is much easier to work with than a stiff one, and results in a considerable saving of time. It is frequently found more convenient to use several layers of thin material for ease in handling. It is here that a good insulator scores over a poorer one, as fewer layers are then necessary.

In handling many fiber and paper insulators, it is almost impossible to avoid creasing the sheet, these materials being usually supplied in sheets or rolls. This brings us to the second point regarding this class of material. This creasing, whether accidental or intentional, should not materially weaken the strength of the material as an insulator. Further, creasing "fiber, presspahn, etc.," destroys the glazed surface, and this makes the material more hygroscopic, and is thus likely to reduce its insulating value. This class of insulator is naturally hygroscopic, and it is almost entirely on the glazed surface that dependence is made to keep out moisture. Care should be taken to inspect fibrous materials other than woven fabrics, as it sometimes happens that pinholes and very thin places are to be found, and at times small particles of metal, such as filing dust, is rolled into the material. Both of these faults are undesirable, the latter especially so.

4. That insulating materials should stand all temperatures likely to be experienced without charring will need no demonstration, but many of this class get brittle when subjected to even "reasonably" high temperatures, and then lose whatever merit they had as to strength, especially mechanical strength. In case of a short-circuit on a machine, the increase of temperature in the portion of the machine supplying current to the short is frequently very great; but it is certainly undesirable that this should necessitate the rewinding of a considerable portion of the machine.

5. That insulators of any description should have a high insulation per mil of thickness is a very important matter, especially in generators and motors, when looked at from the "space factor" point of view. It is surprising what a large percentage of the available winding space is taken up by insulation in generators and motors, more especially in high tension alternating current work.

Having considered in detail the points of good insulation, it remains to consider what tests can be conveniently made with a view to securing as many good points in the insulation used, always bearing in mind that electrical tests are by far the most convenient in a manufacturing works, which is generally far from being a chemical laboratory. Particulars of tests as published by manufactures of insulation are at times misleading, as frequently it is not stated whether the breakdown voltage was with continuous current or alternating current, and if the latter, whether the value is R.M.S. or maximum. Further, some manufacturers test between terminals shaped hemispherically and others between two flat disks. Again, some only test for an instant at the voltage named, merely bringing the voltage up and down again. It is possible, therefore, for the material to break down under a much lower voltage even if only sustained for a short time. Information of this description is of no use to the designer that will readily be understood. Consequently some systematic way of testing all insulating materials is required. This need only be "thorough" on first testing a new material, as there will be probably many evidences visible on mere

inspection which would lead one to expect changes in the material. Subsequently a far less pretentious test will be all that is required to insure repeat orders of material being satisfactory. As the best means for obtaining high pressures, and also of varying the pressure, is by means of alternating current, this, of course, should be used. It must be noted that varying periodicity would give varying results; also that the shape of EMF. curve affects the results in the same way, a peaky curve being more apt to break down the insulation than a flat curve, though both may have the same R.M.S. value. An alternator giving 50 periods and approximately a sine curve of EMF. would be suitable and would correspond somewhat to prevailing practice in alternating current work in England. A variable-ratio transformer is practically indispensable for obtaining the varied voltages required to test the different classes of insulators. Though it may be possible at times to use one of two machines for testing purposes, it is preferable to stick to one (unless the machines are identical), as the more constant the conditions of testing the more reliable is the information obtained. The larger the works and the more elaborate might be the testing, but however simple the apparatus, it is desirable to pressure test all insulating papers, etc., at varying temperatures on first testing unknown materials, afterwards it would probably only be necessary to test at one temperature, supervision being kept over the appearance of all materials, as variations from the standard article are thus detected. Supervision is most essential in connection with varnishes and paints, and attention to appearance should, if possible, be supplemented by testing with the hydrometer to see that the specific gravity does not change. This is partly a check on its chemical constituents, as alteration in chemical composition generally affects the specific gravity.

(*To be continued.*)

Production of Steel by Electricity.

A recent issue of the "Elektrotechnishche Rundschau," of Frankfort, Germany, describes an improved electric furnace, depending on the induction principle that has been operated with satisfactory results at Gysinge in Sweden.

The smelting chamber of this furnace consists of an annular cavity, coated inside with firebrick and closed at the top by lids which are preferably on the floor level. Through the center of this ring one limb of a rectangular transformer core passes, the remainder of the core being completed beyond the ring. The core is, in fact, linked with the annular cavity like one link of a chain is looped with the next. The primary winding of the transformer is placed immediately round that limb of the core which is surrounded by the annular chamber. A single-phase alternating current is passed round this primary winding and induces a flux in the iron core, which, in turn, sets up a current in the material to be melted, the value of this secondary current depending on its primary voltage and the primary turns.

The capacity of the furnace now in operation is 3,960 lbs., and out of this only about 2,200 lbs. to 2,420 lbs. is drawn off at a time, so that the secondary circuit is never quite broken. The rate of production is 9,050 lbs. of steel per 24 hours with a power of 165 kw. The supply is obtained from a 3,000-volt, single-phase generator, and the secondary current through the steel is about 30,000 amperes.

Death of B. E. Greene.

Burton E. Greene, who was connected with ELECTRICITY several years ago, died on Wednesday last at Seney Hospital, Brooklyn. Death was due to heart disease following the removal of a cancer. The deceased was 42 years old. He leaves a widow and three daughters.

Notice About Electrical Congress Papers.

Members of the International Electrical Congress of St. Louis can receive copies of any Congress paper, or papers, in which they are interested, and which were printed in advance, by applying to Mr. H. H. Humphrey, electrical engineer, Chemical Building, St. Louis, Mo. Mr. Humphrey has kindly promised to distribute these papers on application until October 10. We are also informed that written communications by way of discussion from Congress members upon any Congress papers will be received by the General Secretary of the Congress, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass., up to October 15.

Prof. Finsen's Funeral.

A dispatch from Copenhagen, September 29, says at the funeral on that day of Prof. Niels Finsen, the Kings of Denmark and Greece were present, and almost every other European ruler was personally represented, while princes and high ministers of State and leading scientists paid a last tribute to the dead man.

Among these famous personages several more humble mourners were seen—patients whom Finsen had cured.

Vermont Electrical Association Elects Officers.

At the annual meeting of the Vermont Electrical Association, held in Montpelier, the following officers were elected: President, E. D. Blackwell of Brandon; first vice-president, E. E. Gage of St. Johnsbury; second vice-president, G. S. Haley of Rutland; secretary and treasurer, C. C. Wells of Middlebury; executive committee for term of three years, A. H. Bailey of Wells River and E. P. Coleman of Montpelier.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPT 27, 1904.

Electric Railways and Appliances.

770,737. Third Rail for Electric Railways. Albert F. Chase, Haddonfield, N. J., assignor of one-half to Stanley W. Rusk, Philadelphia, Pa. Filed March 17, 1904.

770,744. Trolley. Samuel Fisher and Albert Sanders, Butler, Pa. Filed June 27, 1903.

770,911. Third-Rail System. Leslie M. La Barr, Forest City, Pa. Filed June 22, 1904.

770,960. Third-Rail Insulator. Robert V. Dunbar, New York City. Filed Nov. 6, 1903.

771,027. Signaling System for Electrically-Operated Railways. Lewis B. Stillwell, Lakewood, N. J., and Henry Latey, New York City. Filed May 18, 1904.

771,030. Railroad Signal-Circuits. Eugene W. Vogel, Chicago, Ill., assignor to the Railroad Supply Company. Filed Sept. 20, 1901.

771,193. Electromagnetic Traction Device and Emergency-Brake. Charles A. Wells, Chicago, Ill. Filed May 11, 1903.

Electric Lights and Appliances

770,991. Incandescent Electric Material. August Voelker, Berlin, Germany, assignor to the Societe Anonyme Industrie Verriere et ses Derives a Bruxelles. Filed June 2, 1904.

Electrical Machinery and Apparatus.

770,865. Three-Phase Ground-Detector. Paul MacGahan, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Jan. 20, 1904.

770,873. Controlling Device for Electrical Lifts or Hoisting Mechanisms. Hugo Stahl, Stuttgart, Germany. Filed July 11, 1903.

770,922-923-924. Motor and Electric Motor. Edwin S. Pillsbury and Edward Bretch, St. Louis, Mo., assignors to the H. E. Lindsey Electrical Supply Company, same place. Filed April 17, 1903; July 27, 1903, and Dec. 17, 1903.

770,951. Relay. John C. Barclay, New York City. Filed Jan. 23, 1904.

771,055. Machine for Making Accumulator-Plates. Carl Francke, Schoneberg, Germany, assignor to Hans Helmann, Berlin, Germany. Filed Nov. 4, 1902.

771,150. Variable-Speed Power-Transmitting Device. William F. Howe, Chicago, Ill. Filed Dec. 17, 1903.

771,207. Apparatus for Registering the Supply of Electricity. Gisbert Kapp, Berlin, Germany. Original application filed Nov. 19, 1897. Divided and this application filed Dec. 31, 1897.

Telephones and Telephone Apparatus.

771,114. Switching Mechanism for Intercommunicating Telephone Lines. Albert K. Andriano and Hermann Herbstritt, San Francisco, Cal., assignors, by mesne assignments, to Direct-Line General Telephone Company, same place. Filed Jan. 14, 1901. Renewed April 7, 1902.

771,142. Annunciator. Thomas W. Gleeson, Boston, Mass., assignor to Abraham B. Coffin, Winchester, Mass. Filed July 20, 1900.

Miscellaneous.

770,792. Means for Telegraphing. John Beard Livingston, Mont. Filed April 27, 1904.

770,962. Insulator. Jacob F. Gill, Northeast, Pa. Filed June 2, 1904.

771,086. X-Ray Tube. Carl H. F. Muller, Hamburg Germany. Filed March 15, 1901.

771,144. Thermostat. John D. Gould, New York City. Filed May 9, 1903.

THE TELEPHONE WORLD.

Independent Line to Operate in Montgomery County, Md.

The Montgomery County Telephone Company, which has 450 miles of telephone line in the lower part of that county, from Gaithersburg to Washington, has served notice upon the Boyds Telephone Company, which is controlled by the United Telephone & Telegraph Company of Pennsylvania, that it will sever all connections with that company beginning October 10. The Montgomery and Boyds Companies have been working together for some years, but the former intends to be a rival of the United Company in that section. The Montgomery County system is in connection with the Chesapeake & Potomac Telephone Company, and has connections with all towns in Maryland and the District of Columbia.

Merger of Telephone Companies.

The Citizens' Telephone Company of New Castle, Pa., is included in a deal whereby all the Independent telephone companies in Western Pennsylvania and Western New York are united under the name of the Erie Telephone Company, The consolidated companies have more than 20 exchanges. Additional long distance lines will be built. The company will wage warfare against the Bell Company for trunk line business throughout the territory affected.

The report has been circulated that the Philadelphia, Electric & Keystone Telephone Companies are arranging a "peace" plan. It is said the Electric Company would acquire the conduit property outright with the right to use the conduits for its own electric light wires, and the Keystone Telephone Company would thereafter become a tenant to the extent of paying a rental for telephone wires. In consideration therefore the reported plan is said to provide that the Philadelphia Electric Company take up notes of the Keystone Company outstanding of about $2,600,000. John M. Mack is the leading capitalist in the Keystone, while Thomas Dolan is perhaps the most important one in the Electric.

Bell telephone call rates in Philadelphia will be cut in two November 1, the price being five cents within any of the four districts or zones in which the company has divided the city. The central zone covers 30 of the 129 square miles in the city, and contains 37,500 of its 49,500 telephones.

The Mutual Telephone Company of Des Moines, Ia., is planning extensions of its lines to Adelphi and also to Ivy in the near future. These will not only provide good telephone service for those towns, but will also benefit farmers living along the routes, some of whom now have private lines.

Bertram E. Laciar, manager of the Inter-State Telephone Company, has closed negotiations with the school commission for the installation of Inter State telephones in the public schools of Trenton, N. J.

News from Colorado Springs, Col., states that the El Paso Telephone Company, with a capitalization of $500,000, has been incorporated there.

Burlington Road Will Operate Trains by Telephone.

Recent Chicago advices state that as rapidly as the change can be brought about the management of the Burlington has decided to substitute the telephone for the telegraph in dispatching and operating both passenger and freight trains. This announcement was made after comprehensive trials of the telephone had been made on various portions of the company's lines for several years.

The management stated that these trials had proved eminently satisfactory, and that under the system in vogue there had not been recorded a single instance of mistake in the transmission and receipt of train orders.

In the opinion of the Burlington officials, this removes the main objection hitherto made to the use of the telephone for train operation, the objection of liability to mistake in transmission of orders.

Independents Still Growing.

It is expected that the Independent telephone line which is to connect Pittsburg, Pa., with Wheeling, W. Va., and which is being constructed by the Pittsburg & Allegheny Telephone Company and the National Telephone Company of Wheeling, will be in operation about November 1. The line is being built from Bridgeville toward Wheeling on a private right of way. The new line will add 3,000 telephones at Wheeling to the list of the Independent company, and give further connections in West Virginia and Ohio.

E. T. Gable has sold his half interest in the Cullman, Ala., Telephone Company to S. L. Sherill, of Hartsells, who owns the Hartsells' telephone system. The interests will be combined, and the system improved and extended. A line has been built from Hartsells to Lacon. This will be extended to Cullman, which will give connection between the two points and the Decaturs. Walter Gable, son of E. T. Gable, is the owner of the other half interest in the concern. These two systems are Independent concerns, and giving good service.

The first meeting of the Eustis, Fla., Telephone Company since the receipt of the charter was lately held in the office of H. W. Bishop. The books were opened and the requisite amount of stock subscribed to begin immediate operations. A constitution and by-laws were adopted, and the following were chosen as directors: H. G. Whitsett, H. W. Bishop, Charles Isted, F. A. Reed and J. R. Miller.

The Racket River Telephone Company is placing a number of new conduit or cables to take the place of more unsightly wires in Potsdam, N. Y., and providing for its rapidly increasing business.

E. B. Cooper, of Minneapolis, Minn., has been along the north shore of Lake Superior, looking over the ground with a view to building a telephone line between Two Harbors and Grand Marais. The distance is 110 miles.

The Boone County, Iowa, Telephone Company gave a mortgage for $50,000 to J. H. Herman as trustee to secure 5 per. cent bonds issued to that amount.

Rodents to Lay Telephone Cables.

Rats are in great demand in Sioux City, Ia., according to a recent advertisement of a telephone company there that wanted 200 before November 1.

The rodents will be employed in laying cables in the underground system to be installed in that city.

This is the system: A cord is attached to the tail of a rat and he is turned into one of the sluices in a conduit. A ferret is then shoved into the same passage and it is needless to say that a chase begins. Mr. Rat, intent upon escaping his enemy, hurries to the first manhole, drawing the cord through to the opening. One end is attached to the cable, and it is drawn through with ease. The ferret, which is tethered with a small rope, is drawn back and another line is strung.

The scheme has been tried in Omaha and other cities and has proved highly successful. It offers a sensible solution to the vexatious problem that has always made underground stringing difficult and tedious. Rats now bid fair to become a necessary adjunct to the telephone business, and it is predicted that before long all enterprising companies will keep a regular army of the rodents on hand and ready for instantaneous use.

Arrangements have been perfected which will connect the La Grange, Ga., local telephone system with 125 new 'phones located among farmers in Harris County, who have had a complete system of their own for some time. These progressive farmers will soon be on "speaking terms" with the outside world.

The directors of the Iowa Telephone Company held a meeting in Davenport the latter part of September. President C. E. Yost, from Omaha, and General Manager E. B. Smith and Secretary J. B. Mason, from Des Moines, met with the directors in Davenport. The regular quarterly dividend of 1¼ per cent. was declared.

The Kinloch Telephone Company of St. Louis, Mo., has increased its capital from $2,000,000 to $3,000,000.

The farmers about Rice, O., intend to organize a Farmers' Mutual Telephone Company which will be completed soon.

Telephone Incorporations.

The Lacey Telephone Company, Longview, Tex. Capital stock, $35,000. Incorporators: J. C. Lacy, Edwin Lacy and J. W. Yates, of Longview and Jasper Collins, of Carthage.

The Raymond & Webb Mills Telephone Company, Raymond, Me. Capital stock, $10,000. Officers: President, F. W. Plummer, Raymond; treasurer, O. H. Hall, East Raymond.

The Mutual Telephone Company, Grantsburg, Wis. Capital stock, $100,000. Incorporators: Simon Thoreson, Anton M. Anderson and William R. Ahlstrom.

The People's Mutual Telephone Association, La Grange County, La Grange, Ind. Capital stock, $10,000. Incorporators: John W. Evans, S. Y. Greenwalt, H. D. Pretner, H. B. Garmese, M. P. Miller, J. W. Mills, S. A. Deter, M. J. Yoder, F. B. Cline and J. H. Schermerhorn.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alpha, Ill.—The electric light company is preparing to run a line to Rio. The name of the company is now the Tri-County Electric Light Company, having wires in Henry, Mercer and Knox Counties.

Buffalo, N. Y.--The electric light service here is to be improved.

Cairo, Ga.—The city fathers have ordered an election for October 20 to determine the question of waterworks and electric lights for this place. They propose to put in an excellent plant, if the people so wish by voting for bonds.

Compton, Ill.—The Compton Electric Light Company has been incorporated with a capital stock of $5,000, and will erect an electric light plant. J. S. Richardson. L, W. Kuttler and W. Hills are the incorporators.

Crestline, O.—The citizens have voted to issue $75,000 bonds for the construction of an electric lighting plant.

Durango, Mex.—It is intended to enlarge the electric light plant here—to install more incandescent and arc lamps in the streets.

Hancock, Md.—This town, through which the Wabash extension will run, will be lighted with electricity by the Great Cacapon Power Company.

Horseheads, N. Y.—A proposition for lighting this village with electricity has been presented to the board of trustees by the Elmira Water, Light & Railroad Company through Dr. W. E. Colegrove.

Kellogg, Ia.—The special election recently held in favor of voting for the erection of an electric light plant was carried.

La Belle, Mo.—The citizens are to vote on a proposition to issue $2,700 in bonds to complete the electric light plant.

Lake Linden, Mich.—The Calumet & Hecla Mining Company is planning to install a large electric light plant here.

Lindsborg, Kan.—This town is to have electric lights. The Commercial Club has taken hold of the proposition, and is pushing it with energy and enthusiasm. A committee has charge of the work. It is expected to have the plant established within a few months.

Llano, Tex.—The Buerx Pottery & Mining Company has been incorporated with a capital of $75,000, and will install an electric light plant in its establishment.

McKinney, Tex.—The city council is considering bids for the installation of an electric light plant.

Milwaukee, Wis.—This city is likely to soon begin the erection of a municipal electric light plant. An ordinance authorizing the sale of $150,000 bonds for the purpose has been prepared and will be introduced into the council. It is estimated that a plant of sufficient capacity to meet the needs of the entire city can be erected for $500,000.

Monmouth, Ill.--The Monmouth Gas & Electric Company capitalized at $200,000, has been incorporated to conduct a heat, light and power plant. W. A. Thompson, C. B. Wood and H. S. Oakley are interested.

Norwich, N. Y.—A new electric light company is almost sure to be organized here.

Sedalia, Mo.—Electric lighting is proposed for this town, and is being considered.

Stone City, Ia.—H. F. Dearborn is interested in establishing an electric light plant.

Tennille, Ga.--An ordinance has been passed by the city council calling a special election for October 25, to vote on the matter of issuing bonds for the purpose of improving the waterworks system, and buying the electric light plant installed here, but not in use.

Union City, Mich.--The city council has secured an option on a water power, several miles south of this city, which will be used to operate the municipal waterworks and electric lighting plant here.

Wichita Falls, Tex.--The Wichita Falls Electric Light Company, has been incorporated with a capital of $15,000. I. H. Kempner, Henry Sales and Frank Keil are the directors.

STREET RAILWAYS.

Alpena, Mich.—Eastern capitalists say they want to build a trolley line here, and want a franchise from the council.

Buffalo, N. Y.—Announcement has been made in this city that the New York Central Railroad Company has arranged, through the Marine Bank of Buffalo, to buy the entire production of the Ontario Power Company of Niagara Falls. It is assumed among railroad men there, that the Central will use the power generated to electrify its line between Buffalo and Niagara Falls and Lockport. Later, it is understood the Rome, Watertown & Ogdensburg will be electrified and the West Shore as far east as Syracuse. The Ontario Power Company's plant will have a total capacity of 200,000 hp. It is understood, and in fact has been stated by men in a position to know, that the Trenton Falls power will be used in electrifying the West Shore Railroad east of Syracuse.

Cienfuegos, Cuba.—An electric railway from this city to Cruces, a distance of 23 miles. is now an assured fact. The plans are completed and work will begin this fall. It is expected the road will be in operation in one year. The name of the company constructing the road is the Cienfuegos, Palmira & Cruces Railroad & Power Company. Bruno Diaz is the president, and C. C. Vermuele, of 203 Broadway, New York City, is the consulting engineer.

Denver, Col.—The Denver & Interurban Railway Company, capitalized at $3,000,000, has been incorporated in the interest of the Colorado & Southern Railway. It proposes to have terminals in this city and construct lines to Boulder, Idaho Springs, Louisville and other points in this vicinity.

Eugene, Ore.—The Willimette Valley Railroad Company is now selecting a site for its new power plant to be erected here.

Guthrie, Okla.—C. H. Martindale, of this city, has made a proposition to the city council for the constructing of a new electric railway line.

Hutchinson, Minn.—J. T. Jenkins, of Hector, and F. M. Funson, of Minneapolis, are trying to secure a franchise to establish an electric railway here.

New Castle, Ind.—The city council has granted a 50-year franchise to Frost Hernly for an electric line from Indianapolis to this city.

Oshkosh, Wis.—The Oshkosh & Western Electric Railway Company has been organized for the purpose of building an electric railway line from Omro to Berlin.

Philadelphia, Pa.—A new power house is to be erected at Ridley Creek for the Philadelphia & West Chester Traction Company.

Scranton, Pa.—The Scranton, Factoryville & Tunkhannock Electric Railway, 30 miles long, is to be built at once.

POWER PLANTS.

Albuquerque, N. M.--It is stated that the newly incorporated Electric Power Company contemplates the erection of an immense power plant here, to cost about $75,000. C. K. Durbin and W. S. Iliff are interested.

Zamora, Mex.--The Guanajuato Electric Light & Power Company, which owns the power plant on the Duero River, near this city, and the transmission line to the city of Guanajuato, has decided to build branch transmission lines to La Barca in the State of Jalisco, and Celaya, Guanajuato. Several hundred horse power can be utilzed in both places for city lighting and the operation of various industries. The company recently entered into a contract with Oscar Braniff, to supply current to the extent of 500 hp., to the city of Leon, and the branch line to that point is now in the course of construction. Arrangements are being made to generate additional current up to 8,000 hp. at the plant here.

BIDS WANTED.

Washington, D. C.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until October 11 for furnishing the New York Navy Yard with the following electrical apparatus: One 65 hp. motor; 15 motors, inclosed type, 1 to 5 hp.; one 5 hp. induction motor; 6 generating sets; two 2½ kilowatt generating sets; 5 Weston voltmeters, and other instruments; 7 Leeds & Northrup instruments; one 110-volt induction coil; 150 lightning arresters; four 3-pole, 220 volt weatherproof fuse and service cut-out boxes for 300 amperes, and a large quantity of bracket fans, conduit and fittings, telephone wire, etc. Specifications and blank forms of proposal may be obtained upon application to the Navy pay office in New York or to the Bureau here.—The Bureau is also inviting sealed proposals until October 11, for furnishing electrical supplies as follows: For the Norfolk Navy Yard—190 arc lamps; 7,662 incandescent lamps, various candle-powers; arc lamp inner globes; arc-lamp carbons for inclosed lamps; insulating tape; 30,000 feet rubber-covered wire; about 50,000 feet of various kinds of wire; bracket fans and fixtures; starting panels, inclosed fuses; 10 automatic switches, outlet boxes, insulators, switches, sockets, etc. For the Port Royal Naval Station—12 recording wattmeters; 5 Jandus inclosed arc lamps, and 12 clutches for some 150 incandescent lamps and other electrical material. Specifications and blank forms can be obtained at the Navy pay offices in Norfolk and Port Royal, or upon application to the Bureau.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, $12\frac{3}{4}$@$12\frac{7}{8}$c.; Lake $12\frac{7}{8}$@13c.; casting, $12\frac{1}{2}$@$12\frac{5}{8}$c.

The Hudson River Telephone Company has declared its regular quarterly dividend of $1\frac{1}{2}$ per cent., payable October 15.

Metropolitan Street Railway interests in New York are negotiating to sell real estate valued at nearly $5,000,000.

It is now believed that J. Pierpont Morgan is backing the negotiations for a merger of all of Chicago's surface electric railways.

Investors have been absorbing Consolidated Traction of New Jersey stock; the price Saturday reached $72\frac{7}{8}$, with final sale at $72\frac{1}{2}$.

Industrial dividends payable in New York for October amount to $24,345,371 compared with $21,500,026 for the corresponding month a year ago.

The New York & New Jersey Telephone Company has declared the regular quarterly dividend of $1\frac{1}{2}$ per cent., payable October 15 to stock of record October 5.

N. W. Harris & Co. of New York purchased in the open market $2,000,000 of the first mortgage bonds of the United Electric Light & Power Company of Baltimore.

The stockholders of the Manhattan Railway Company will hold their annual meeting in this city on November 9 to elect directors. Books close October 8 and reopen November 10.

A plan has been perfected to reorganize the finances of the St. Louis Transit Company and the United Railways Company of St. Louis, and to reduce the capitalization by $33,000,000.

A director of the Metropolitan Securities Company of this city says: "There has been no suggestion in the board as yet of a further assessment on the stock and I do not expect one in the early future."

The net earnings of the Massachusetts Electric Companies for 11 months and the gross earnings for September show an amount equal to about 2 per cent. on the preferred shares which was paid July 1 last.

At 101 Saturday Twin City Rapid Transit reached the highest price of the year. The improvement in this stock is understood to be regarded as a discounting of an advance in the dividend rate from 5 to 6 per cent.

Holders of about 80 per cent. of the outstanding Connecticut Railway & Lighting Company first and refunding $4\frac{1}{2}$ per cent. bonds have accepted the offer of the United Gas Improvement Company to guarantee the interest on the bonds.

The Sovereign Engine & Construction Company, New York, has been incorporated to manufacture and deal in electrical machines with a capital stock of $30,000. The incorporators are E. L. Crandel, E. L. Abbett of New York and C. E. Hunter of Brooklyn.

The Buffalo, Batavia & Rochester Electric Railway Company, Buffalo, N. Y., was incorporated at Albany on Monday with a capital stock of $3,500,000, to construct a 65-mile street surface railway. The directors are Loran L. Lewis, S. R. Mann and Spencer Kellogg, Buffalo.

The Middletown (Conn.) Street Railway Company was sold Saturday to the Consolidated Railway Company. The deal has been contemplated for several weeks, but not until Saturday did the officials of the Consolidated reach an agreement. The sale was effected at the rate of $15 per share of stock the par value of which is $25 per share. The capital stock of the company amounts to $135,000.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Oct. 3.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	154
Metropolitan Street Railway	$121\frac{3}{4}$
Metropolitan Securities	85
Ninth Avenue	197
Third Avenue	129
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	$58\frac{1}{4}$
Public Service Corporation (New Jersey)	101
Philadelphia.	
Consolidated Traction of New Jersey	$72\frac{1}{2}$
Philadelphia Traction	$97\frac{7}{8}$
Union Traction	$56\frac{1}{2}$
Boston.	
Boston Elevated	$154\frac{1}{8}$
Massachusetts Electric Companies, com	$14\frac{1}{8}$
do. do. do. pref.	58
West End Street, com	91
do. do. do. pref.	110
Chicago.	
City Railway	$178\frac{3}{4}$
North Chicago	71
Union Traction, com	$7\frac{1}{8}$
do. do. pref.	36
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	$11\frac{7}{8}$
do. pref.	50
Electric Boat, com	40
do. do. pref.	73
Electric Lead Reduction	$\frac{3}{4}$
Electric Vehicle, com	$16\frac{3}{4}$
do. do. pref.	$24\frac{1}{2}$
Westinghouse, com	$164\frac{1}{2}$
do. pref.	190
General Electric	$173\frac{1}{2}$
Boston.	
Edison Electric Illuminating	$257\frac{1}{2}$
General Electric	$173\frac{3}{4}$
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	150
National Carbon, com	35
do. do. pref.	109
Philadelphia.	
Electric Company of America	$9\frac{5}{8}$
Electric Storage Battery, com	65
do. do. do. pref.	65
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	$139\frac{5}{8}$
Western Telephone Company	13
New England Telephone Company	$129\frac{3}{4}$
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	210
Mexican Telephone Company	$1\frac{1}{4}$
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	91
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	35
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

High Tension Lightning Arresters. in Power Stations.

When a high voltage power line was run from Niagara Falls to Buffalo, electrical engineers in Europe as well as America watched the proceedings with the greatest interest. Prof. Forbes, in a sense, initiated the plan, acting as consulting engineer and overseeing the development of the work.

Since then plants of a corresponding character have been erected in various parts of the country, particularly in the far West. The voltage employed has steadily risen from what was at first regarded as enormous, namely, 5,000 volts, to voltages of 10,000, 15,000, 30,000, 40,000 and finally to 60,000 volts. These high pressures, a menace in themselves to the lives of those intrusted with the care of such installations, become more terribly dangerous under circumstances that bring into play the effects of lightning. As a rule these plants are run by water power and are situated in some rocky fastness exposed to all the eccentricities and possibilities of danger arising from heavy lightning discharges, which are peculiarly playful in these localities. The protection offered is in the shape of lightning arresters. The most improved types at present in use for the protection of high pressure plants are arranged in series. When the electric potential becomes too great, the arresters are supposed to lead the discharge to the earth, and, in doing so, it leaps through an air gap, provided in these arresters, to the ground connection. Some of these arresters are supplied with paths instead of air gaps, of exceedingly high resistance, so as to prevent, in a way, the possibility of failure. In spite of the varied designs and attempts to control this disruptive discharge the plant frequently suffers. The design of arresters calls for an intimate knowledge of the relationship between a rapidly oscillating current and the self-induction of the conductor it passes through. If some way could be found to offer a choice of paths of different resistances and different inductances to these abrupt, and, in some cases, stupendous tidal waves of pressure, an assurance would be felt that at present does not exist—at least to such an extent, that in plants of 60,000 volts, when lightning is playing about, the electricians in charge would feel that the machinery and their persons were perfectly secure.

* * *

What is Wanted in Incandescent Lamps.

Like everything else, time introduces changes in the character and application of old inventions. As an example, the steam engine is about to divide the field with a worthy competitor, the steam turbine, and in a similar manner many hybrid types of lamps have appeared on the market which were invented for the ostensible purpose, to use a hackneyed expression, "of filling a long felt want." What this want is, is to some a difficult thing to understand, yet in the light of modern science and present progress, a distinct necessity has arisen.

A brief resume of the subject with respect to incandescent lamps, teaches us that these light producing devices can only succeed if their design and construction are based upon certain conclusions, which might be termed the light-giving, and the efficiency-giving principle.

These ideas, which are fundamental with respect to this problem, are reduced to methods of comparison by referring to

them as candle power and watts per candle. So the problem narrows itself down to a consideration of the amount of light a lamp produces and its cost in power per candle. How to obtain plenty of light from little power, without involving a great expense and trouble in the construction of the light-producing device is the thing required.

How do we stand at present in this respect? This question might be answered by saying that while progress has been made in the cheapness of construction of incandescent lamps, which of necessity has been a great aid to electric light companies, and the public at large, the improvement in the lamp itself as regards efficiency stands about the same. Comparative perfection has been reached in the generators, in the system of lighting of which they are an indispensable part, and in the plan of wiring through which the current is economically transmitted and distributed, but when we come to the lamp, there we meet with a standstill. The lamp taking three watts per candle power still dominates the field, and all the efforts of the inventors of vacuum tube systems and mercury vapor systems and lamps with rare oxide filaments, these, we are sorry to say, while they represent interesting departures, are more experimental than successful, more scientific than practical, and for that reason there is still a want, a demand, if it may be so called, for a lamp to give more light that takes less power—a lamp which represents a distinct economic departure in both principle and construction.

* * *

Rapid Transit. Rapid transit in Manhattan Borough has proven a success so far as speed goes. At least so the daily papers say, and the few who were invited last week to ride through the subway on the "special." The train started from the Brooklyn Bridge station and ran to 145th street in 16 minutes and 10 seconds.

The start was made from the Bridge at 2:23 o'clock, and 20 seconds later the train slipped past Worth street, Bleecker street was passed in 1 minute and 50 seconds, and in exactly 2 minutes 14th street was crossed. The Grand Central station was reached in 5 minutes and 30 seconds. In 6 minutes and 20 seconds the train went round the curve at 42d street and Broadway, and in 8 minutes and 5 seconds the Circle was reached. It shot past 72d street in 9 minutes and 20 seconds, and 96th street in exactly 11 minutes. From this point to 145th street the speed was increased, 125th street being passed in 14 minutes and 25 seconds, and 145th street, the stopping place, in 16 minutes and 10 seconds.

The distance traversed in the above time was approximately eight miles, which is not extraordinary going, except in view of the fact that the subway is new and the machinery untried. It should be possible later, when things get in good working order, to reduce this time by several minutes. Sixteen minutes to 145th street, however, now probably seems fast as compared to the time made by the elevated road expresses, but it is a well known fact that a train cannot run as speedily on an elevated structure as on a track laid on a solid foundation.

A number of daily papers heralded the feat last week as a "remarkable run," but it is hard to see how a mile in two minutes can be called "rapid transit."

On Monday the Rapid Transit Commission and its chief engineer, William Barclay Parsons, made an official inspection trip through the subway. The object of the trip was to give official approval of the safety devices prior to giving the company permission to carry passengers.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Preparations for testing the electric locomotives built for the New York Central have been completed and the trials are expected to begin this week. They will be run at high speed over a stretch of track with third rail built especially for this purpose.

Indications are that the copper exports for October will exceed those of September, which were about 20,000 tons. A material advance in prices is looked for.

The Department of the State Railways of Roumania is about to award contracts for the enlargement of the electric lighting plant at Bukharest and for material and machinery required for electric lighting and furnishing power for the new railway shops in that city.

The Chicago city council recently defeated, by the narrow margin of five votes, the proposition to submit to the voters the question of municipal operation of street railways.

An electric traction system is to be built in Leith, one of the principal seaports of Scotland, located on the east coast, near Edinburgh.

The apparatus and machinery of the mechanical and electrical departments of the Alabama Polytechnic Institute at Auburn, have been moved into their new laboratories, and these increased accommodations will give still greater efficiency to these successful departments.

The main entrance to the Subway station at the City Hall is to be adorned shortly by three bronze tablets, which will commemorate "the first municipal rapid transit railroad suggested by the Chamber of Commerce, authorized by the State and constructed by the city." On one tablet appear the names of the engineer, architects, etc., and on another the names of members of the construction company and the contractor. On the main and central tablet are the names of rapid transit commissioners, mayors, builders, chief engineer, counsel, secretaries and the president of the Rapid Transit Construction Company.

In about a week work will be started to install the wireless telegraph system between the General Electric Works in Schenectady, N. Y., and the plant in Lynn, Mass. This line will be used exclusively for the business messages between the two works. Installation will be started in both cities at the same time.

Gen. Greely received a dispatch from Major Edgar Russell of the Signal Corps announcing that the cable ship Burnside, which has been engaged in laying a cable from Valdez, Alaska, buoyed the eastern end of the cable at the mouth of Sitka Harbor ten days ago. It will probably require several days to make the shore end connections and throw open the cable to commercial business. This completes the Alaskan telegraph system, which has been under construction for three years, in which time about 4,000 miles of land and sea lines have been laid, and it brings the Nome and Behring Straits regions into direct communication with the United States over an all-American route.

A number of farmers of Kane County, Ill., have been experimenting for a year past with electricity. Their purpose is to make the electric motors supplant nearly all human and horse labor on the farm. Their success has been so marked that in that great milk and butter section it is now only a question of installing motors before every farmer of importance will do the heavy, and in the past costly work, of his land through the turning of an electric switch.

SCENES AND EXHIBITS AT THE ST. LOUIS EXPOSITION.

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BY FRANK C. PERKINS.

Among the important exhibits in the Electricity Building at the St. Louis Exposition is that of the National Electric Company of Milwaukee, shown in the foreground of the accompanying illustration, Fig. 1. There is in this space a fine exhibit of air-brake equipment as well as electrical machinery, as this company is successor to the Christensen Engineering Company. This exhibit in the Electricity Building includes a 150 kw. direct current generator driven by a 20 hp. motor of 220 volts pressure, also a 150 kw. alternator of 3,200 volts and a 10 kw. motor generator set. A 60 kw. 500 volt direct current dynamo is belt driven by a 220 volt motor of 30 hp. capacity, while the largest machine shown in this space is a 400 kw. generator of the direct current engine type. The overhead electrically driven traveling crane, shown in Fig. 1, is exhibited by Pawling & Harnischfeger, of Milwaukee, and has a maximum capacity of 30 tons with a span of 57 feet 5 inches, the bridge being in riveted box sections. This crane is equipped with a 5 ton auxiliary hoist, the auxiliary tackle of two parts of ⅜ inch wire rope. The hook lift is 36 feet 5 inches with main tackle of 10 parts of ¾ inch wire rope. The total weight of the crane is 68,000 lbs. and the weight of the runway rail is 60 lbs. American standard. The main hoist is operated by a 35 hp. motor, which gives a speed of 12 feet per minute at full load and 30 feet per minute at light load. The auxiliary hoist motor has an output of 15 hp., the speed at full load being 30 feet per minute, and with light load 90 feet per minute. The motors operating this crane are supplied with a direct current of 220 volts pressure. For bridge and trolley travel the electric motors provided are of 30 hp. and 8 hp. respectively, the former driving the bridge at a speed of 400 to 500 feet per minute at full load and light load, while the smaller motor operates the trolley at a speed of from 100 to 150 feet per minute.

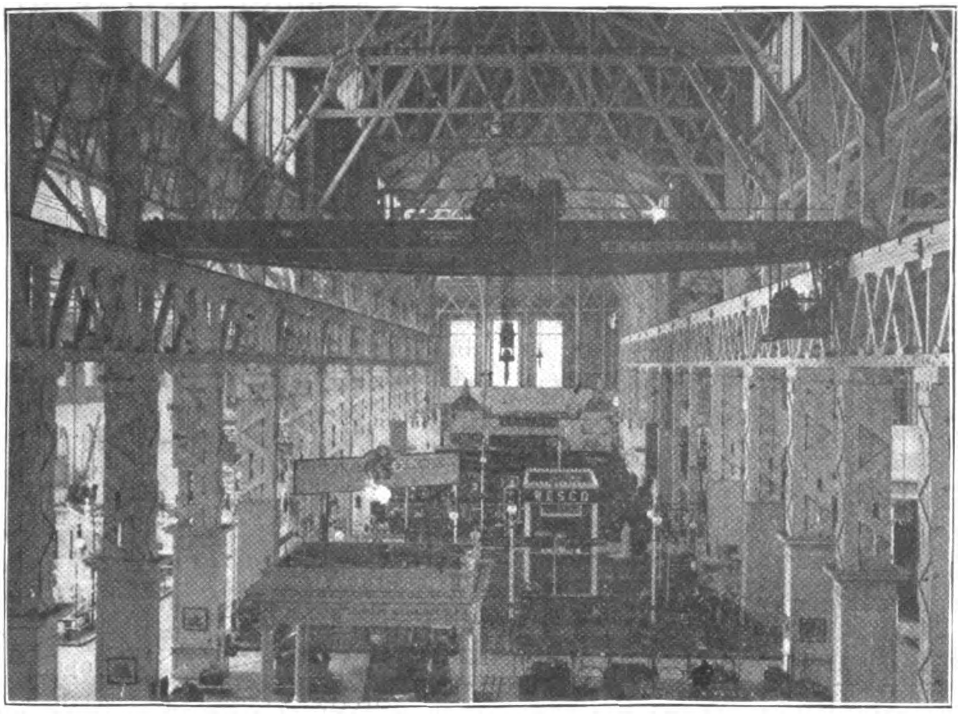

Fig. 1.

Among the other exhibits in this section of the Electricity Building, to be seen in the background of Fig. 1, will be noted those of the Triumph Electric, the Northern Electrical Manufacturing Company, of Madison, and the Western Electric Company of Chicago. Among the more artistic booths in the Electricity Building should be mentioned that of the Weston Electrical Instrument Company of Newark, N. J., noted in the accompanying illustrations, Figs. 2, 3 and 4.

This exhibit includes the well-known Weston high-grade ammeters, voltmeters and wattmeters for switchboard and laboratory work. Other exhibitors of electrical measuring instruments include the Compagnie Anonyme Continentale of Paris, Hartmann Brown A-G of Frankfort-on-the Main, Germany, and Kelvin and James White, Limited, of Glasgow, Scotland, as well as the Cambridge Scientific Instrument Company of Cambridge, England.

Fig. 2.

The telephone exhibit of the Baird Manufacturing Company is located in the southeast corner of the Electricity Building, and includes an excellent showing of telephone pay stations, telephone time stamps, peg counters, and call registers. The pay stations are provided with a mounting plate by means of which it can be attached to either the common battery or magneto-telephone. It is arranged with a pocket rejector for returning coins deposited in the wrong slot by mistake, and a flipper, by means of which all the slots are closed when the coin has been placed in the machine, and remains there until the lever is pulled and the signal given.

A unique device is shown in the Wagner electric exhibit in Section 9, called the Orgobolo, constructed by the Organ Power Company of Hartford, Conn. This electrical blower for organ work is said to be highly efficient and practically noiseless, the compound orgobolo using a slow speed motor and raising the wind pressure step by step by a series of fans giving very high pressure where desirable.

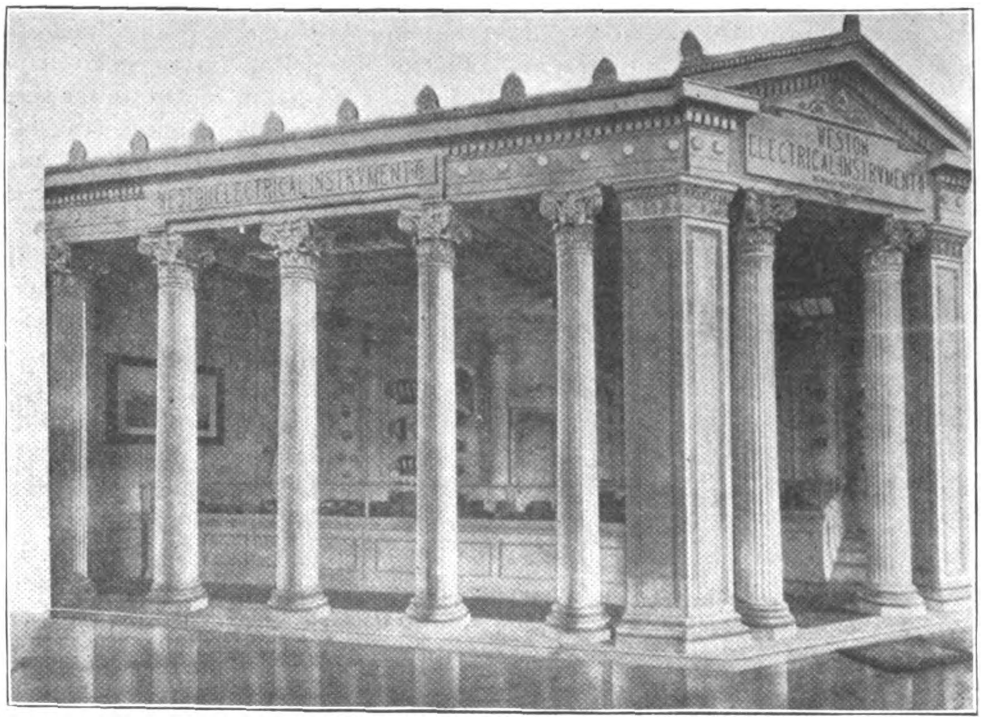

Fig. 3.

The line of Hylo specialties, exhibited by the Phelps Company of Detroit, Mich., comprise two distinct groups, including a group of turn down lamps, and one of devices adapted to decorative and display lighting. The original Hylo lamp, in which the light is varied by turning the bulb in its socket, is adapted to a great variety of uses. This lamp has been supplemented by the Pull String type, in which the light is turned up and down and out by pulling either of two cords appending from the lamp about one foot. This lamp is adapted to cases where the socket is a little too high to reach easily. For porch lanterns, ceiling clusters, and other places where a wall switch would ordinarily be used the long distance Hylo lamp enables the light to be turned up and down as well as out. This lamp has a pendant switch and clips which snap on like a glove fastener, thus requiring no tools. The cord may be made long and carried to the bed, so that the light may be turned up and down without rising. The Hylo turn down lamps are all attractively displayed at the Phelps Company's exhibit, showing a furnished room, and also a wax figure, which is perpetually turning the light up and down just outside the door.

The other branch of Hylo specialties relates to electric signs and display lighting generally. The chief of these devices are the self-flashing sign lamp and Skedoodle Socket Plug. The self-flashing sign lamp is a Hylo lamp with big and baby filament, and having a flashing mechanism concealed within an ordinary Edison base, which perpetually turns the light up and down from 1 to 16 cp. many times a minute. The Skedoodle Socket Plug is an insignificantly small device adapted to screw into any ordinary Edison socket and hold any ordinary Edison base lamp. When the current is turned on the plug will, after a few minutes, begin flashing the light on and off. It is stated that some of the self-flashing sign lamps have been used as long as 6,600 hours, the tireless Skedoodle keeping busy all the while.

Fig. 4.

THE TELEPHONE PATENT SITUATION *

BY EDWARD E. CLEMENT.

We are met here for one purpose, which all present, I believe, hope earnestly may be accomplished. I refer to the formation of a strong, representative and truly national association, which shall not only serve to unite and harmonize the operations of the various State organizations, but shall furnish an offensive and defensive alliance in the best and fullest sense. The necessity for such a body is strongly apparent, and its effect, not only in strengthening the market for telephone securities in insuring protection from patent persecution in the courts, but in adding to the facility and ease of transaction of business, cannot be overestimated.

With regard to patents, it is far too soon to consider the field as open. On the contrary, in this case, as in every other, eternal vigilance is the price of liberty. The old association has done excellent work in defending the suits brought under the Berliner and other patents, but its future work, if properly

*Abstract of paper read before the Independent Telephone Association of the United States at its eighth annual convention held at St. Louis, September 22, 1904.

carried out, will be even more important. Day by day more patents are being issued, month by month the Bell interests and the Independents alike are acquiring new leases of monopoly on the application of principles which in the near future will become essential to the operation of high grade systems. The Patent Office is issuing an average of over 30 patents a month, and whereas a few years ago two examiners could handle the class of telephony, it now takes four, with the assistance of a fifth, and they are overworked. Few people have any adequate conception of what the patent situation has meant in work and money expended. I will give you a few figures to illustrate.

There have been issued 4,298 telephone patents, of which 3,798 are in the class of telephony proper and 500 are scattered. I do not include in this number all the patents for electric lighting, power generation and distribution which have a bearing on telephone systems as installed, but I should say there are probably 500 more of these. The modern telephone plant is not essentially telephonic. It comprises really a power generating and distributing system, with auxiliary telegraph system, whereby the supply of power is controlled. The only things telephonic about it are the transmitters and receivers at subscribers' stations and the central office.

Of the 3,798 strictly telephonic patents, that is, those so exhibited and classified, 327 are for receivers, 683 are for transmitters (of which 216 relate to the granular type), 469 relate to exchange systems and 715 to switchboards, of which 465 cover multiple boards exclusively and the rest single or transfer boards. About 75 of the system patents also relate to multiple boards, and nearly 300 cover circuits which are applicable thereto. Ninety-five apply to exclusively transfer systems, so the preponderance of choice in the favor of the multiple board is thoroughly apparent. Of intercommunicating or house systems, there are 57 patented, and of party-line systems, 577. Of the latter, 200 employ step-by-step selective mechanisms, and I believe there are two things every man who has an idle hour tries his hand at. These are car couplings and step-by-step telephone selectors—both classes absolutely overworked.

There are 160 patents for transmitter arms and receiver supports, and 211 switch hooks. Last, but by no means least in importance at the present time, there are 125 patents for automatic exchange systems and apparatus. The actual number of automatic patents is small, but I assure you they must be measured by weight to be appreciated. No living man knows all the details of all the apparatus in those 125 patents, and no man ever will, not even the inventors themselves. Some of the devices are fearfully and wonderfully made, and some are distinctly abortions.

In these patents, I estimate, there are altogether 48,038 claims, each, of course, standing as a distinct patent for what it covers.

The patents have cost:

Government fees	$150,430
Attorney fees and expenses	200,000
Interferences	300,000
Total	$650,430

This is what the patents themselves cost. It does not touch the value of the inventions, nor the amount at which they have been capitalized, which has, of course, run into many millions. Nor does it touch the cost of litigation, past and present. For all this the people at large have to pay sooner or later. The manufacturer or operator is only a middleman, who collects on the one hand and distributes on the other. Out of the total number given, about 1,800 or 2,000 are owned or controlled by the Western Electric Company and the American Telephone and Telegraph Company (Bell).

Assuming that 20 per cent. of the patents in the class of telephony have expired, and that 30 per cent. are invalid or worthless, there remain 24,000 in force, many of which probably need serious consideration. A respectable percentage of these 24,000 belong to Independent companies or individuals, but I wish to point out that, without more than a friendly understanding (which binds nobody), this is no guarantee that suits will not be brought on them. If the Independent companies, both operating and manufacturing, stand together, the Bell interests can never again do them serious damage by patent suits; and the growth of public sentiment in favor of Independent investments will be sure though slow; but if any amount of litigation develops among the Independents themselves, it will be the very worst thing that could happen, and must have a very depressing effect. The weakness of a house devided against itself is proverbial, and so surely as the larger Independent companies are gathering the elements of monopoly into their hands, so surely will division come. I know that men do not spend money in development and patents out of charity, nor do I mean to depreciate the full protection of every man's property; but surely there must be some division line between those things that are essential and those that are not. There are many patents on transmitters —683 in all—and the transmitter is a common necessity. Of the 216 granular instruments patented, probably 100 belong to Independent owners, and more are coming as fast as patent attorneys can hatch up new excuses for them. There are 327 magneto-receiver patents, of which probably 75 are modern and in Independent hands. Suits on such patents as these, where they cover only differences in details, should be discouraged. Of course, no one can be absolutely deprived of his right to go into court, but a strong restraining hand would tend to avoid scandals. My suggestion upon this point would be that a national arbitration board be appointed, and that it be made absolutely obligatory upon all members of the association or its component State associations, as well as upon those nonmembers with whom they deal as purchasers, to submit all disputes or questions of infringement to this board before going into court. They need not disclose their proofs necessarily; but if a charge of infringement be made, the board should have an opportunity of passing upon the prima facies, so that if, upon the face of things, the complainant had not a righteous cause he would go on with the official stigma attached to him, stamped "disapproved." This board, of course, would have to be made up of disinterested men of sufficient standing and technical knowledge to give their decisions weight. I believe such an arrangement would tend to discourage litigations over trifles, and, in my belief, large causes of dispute are few and far between.

With regard to the important suits of the past, or likely to be brought, especially by the Bell, in the future, the broadest patents are all expired, and the most threatening ones are out of business, temporarily or permanently. The Firman multiple-board patent, the Haskins and Wilson busy-test patent, the Seeley answering-jack patent, and the Bell common battery patent are all gone forever, while Berliner is on the shelf along with the narrow subject matter to which he was restricted and which no one wants to use.

The Scribner patent 330,061 (expired) was sustained against the switchboard now in use at Mobile, Ala., but resulted in no other damage to the interests of the Independent telephone business. The Carty patent for the arrangement of bridging bells in party line work was sustained in the Millheim case, but was reversed in the Anthracite case, and is

now awaiting final decision by the Court of Appeals.

The suits brought by the Western Electric Company against the Western Telephone Construction Company on patents, 215,833 to Rosevelt (79 F. R.) and 270,-522 to Watson (81 F. R., 572) and against the Williams-Abbott Electric Company on the Gray patent 309,617 (108 F. R., 952), all resulted in defeat for the patents sued on and established the right of the public to use the various switching and switchboard devices alleged to have been covered by them.

More recently Judge Wing decided against the Western Electric Company on suits brought by it against one of the Independent manufacturing companies for the alleged infringement of four of its patents (357,358, 477,616, 488,033 and 552,729), involving the construction of spring jacks and annunciators, while suits on the five common battery patents to Bell 346,708 (expired), Stone 507,568, Scribner 559,616, Kitsee 430,960, and Hayes 474,323, brought by the American Bell Telephone Company against certain Independent operating companies, and suits brought by the Western Electric Company on patents 575,653, 488,038, 431,531, and 11,929 (reissue), against other Independent telephone companies, have been indefinitely suspended awaiting the decision of the United States Court on the alleged illegal purchase of the Kellogg Switchboard and Supply Company by the Bell interests. Numerous other patent suits have been brought and subsequently abandoned by the Bell interests, while suits on a number of patents, including 427,629, 669,708 and 667,463, in addition to those previously mentioned which have been indefinitely suspended, have as yet received no action from the courts.

Another decision was rendered recently in Rochester on a Bell patent, which will be welcomed generally. I refer to the Scribner patent 559,411, covering the control of supervisory lamp in the third conductor in the cord. The patent is declared invalid, I am informed, and this opens one more door, which is of some importance.

On the whole, I can see no reason to fear successful attack along any important line from the Bell Company. I do not mean by this that there will be no suits, but they will be brought for effect only, and the effect can be discounted, if not entirely destroyed, by a united and harmonious stand. With the same amount of reasonable precaution and the same investigation that an investor in any other field would feel bound to make, every assurance can be given that success will continue to crown our banners in the future, as it has in the past.

Independent telephone securities are absolutely safe, so far as patent suits now being prosecuted or to be brought in the future by the Bell people may go. All that is needed to create confidence is union. I trust, in closing, I may be permitted to express my earnest hope, as one who has been with this movement since its birth, that its end will be more glorious than its beginning, or, in Oriental phrase, "May the end of this house be peace."

ON INSULATION,*

(Concluded from page 193.)

Taking tests for the specific points, mentioned for insulating materials, in the order named, we have for paints and varnishes:

1. Quick Drying.—This is merely a matter for trial, and can be done in the open air or in a drying stove, as desired.

2. Elastic Strength.—This may be tested by coating a piece of presspahn, tin or copper (metal for preference) and when dry bending backwards and forwards. An electrical test can also be made after the bending, to see if this has affected the insulating material.

3. High Melting Point.—First dry off the liquid components and then heat the residue, and see at what temperature it melts. If the drying was done in a thin layer, it would also be possible to note when it commenced to char.

4. Affecting Copper.—Copper strips may be coated and examined after an interval (which is practically working conditions), but a quicker way is to put copper filings into a quantity of the varnish. They will readily show if the varnish will in any way affect the copper.

5. Waterproof, etc.—The varnish or paint could be tested on some plant about the works, where there is generally some motor or other running under adverse circumstances as regards oil, etc. A test might be made of a piece of metal left exposed to the elements for some considerable time.

6. This we will deal with later, along with 4 and 5 for fibers, etc.

Taking now fibers, papers, etc., we find

1. Pliability.—This is, of course, purely a matter of trial.

2. Creasing.—A good test to subject the material to is to make two creases crossing each other. This is likely to be as severe as anything short of an actual tear.

3. Non-Hygroscopic.—This might be tested by immersing all samples systematically for a short time in water and then testing for breakdown after drying the surface.

The tests for 4 and 5 for fibers, papers, etc., and for 6 in varnishes and paints, can conveniently be made in a felt-lined box, heated by either lamps or a resistance frame, the latter for preference if the higher temperatures are desired. If a thermometer be fixed projecting into the box, the desired temperature is easily noted, and can be regulated by varying the current through the resistance. The box should be fitted with two terminals about 1½ inches in diameter, the flat surfaces having the sharp edge rounded off to prevent excess of pressure at these points. If one of the terminals be fitted with a flat spring, a fairly uniform pressure will be secured, as the thickness of the samples tested does not vary within very wide limits. Ordinary instruments would be necessary for reading current and voltage, the ammeter indicating at once the breakdown of any specimen under test. It is the systematic recording and making of these electrical tests that enable the designer to make the most of the materials at his disposal. They also, as previously noted, keep the materials used up to sample, and therefore more reliance can be placed on the work of the various departments. One point remains to be emphasized in pressure testing, and that is that the breakdown strength is not proportional to thickness, especially in the case of fibers and such like materials, which are built up in layers. It would appear very difficult to get rid of moisture in the thicker sheets, and this brings down the insulating strength.

A very important test which should not be overlooked is the galvanometer test for leakage, as some materials may be good against piercing and yet be bad from a leakage point of view. Take mica paper for instance. This, if the mica is well laid—that is, with all joints well lapped—will show well under a disruptive test, but for leakage would depend entirely on the mucilage or varnish with which the mica flakes are built up. Failing a standard galvanometer testing set, a rough test may be made by testing against a known good insulator and noting the discharge and the length of surface over which it takes place. This can only be done when the thickness of the piece tested is secure against breakdown from the pressure applied to obtain this dis-

*From the "Electrical Engineer," London.

charge. Every care should, of course, be taken to accurately gauge the thickness of material under test, especially at the point of breakdown.

In conclusion, it may be said, that attention to this question of insulation is amply repaid, and it is well to bear in mind that it is not well "to spoil the ship for a ha'porth of tar."

THE CARE OF SWITCHBOARDS.*

It is surprising to notice, in visits paid to central stations for the supply of electricity, evidences of the fact that, while systematic attention is devoted to the cleaning of the buildings and mechanical plant, and some little effort is made to keep the electrical running machinery in good order, very superficial notice is often taken of the condition of the switchboard. An instance of this came under our notice at a station whose switchboard was of the "flat-back" type. The marble front was beautifully clean, the glass and brass of the instruments were brilliant in their polish; but the engineer was unwise enough to show us the back of the board. A heavy coating of dust lay on the bus bars and cables, a mop and pail of water stood in one corner adjacent to a resistance frame, and balanced on the angle-irons of the framework was an assemblage of pint-pots, cups and parcels of food, this portion of the board being evidently reserved as a pantry by the switchboard attendants. This laxity is all the more astonishing because the board is the point of assemblage of all the power developed by the plant in the station prior to its departure to the feeding points of the system.

The reason for such neglect is probably that, with a continuous supply, the board is never entirely available for overhauling and cleaning. Parts which are in operation, or regarded as "spare," are exempted from strict examination owing to risk of life or other causes. The danger of this is, however, apparent to anyone who has had the opportunity of seeing what dust can do in increasing leakage and noticing the effect of loose connections in increasing the drop of volts in a bus bar.

A switchboard should be subjected to a detailed examination as often as, and of as severe a nature as that of the rest of the plant, which, although perhaps occupying more space, is, after all, only of the same power capacity of the board. This should be undertaken by the engineer-in-charge, and he should be particularly on the alert for loose connections. It is not a wise policy to wait until a screw drops out and an open circuit is formed before making an anxious investigation and a penitential report. A half-hour spent with a spanner and screwdriver, say, once a week, may save the credit of the station. It must be remembered that in a power house there is nearly always vibration constantly tending to jar connections loose. Alternate expansion and contraction of metal parts by heating as current is passed through them or interrupted aids vibration in making these parts work loose.

Dust in an engine room is usually rather oily, and where it touches it sticks. Moreover, parts charged to a potential differing from that of earth attract and retain light particles of dust. In some stations a small portable motor-driven air compressor is used in order to blow the dust off electrical fittings, and the introduction of such appliances should not be discouraged. But it is not safe to rely on this method, partly because the general application of an air-blast tends to diminish the detailed examination of the insulating part of the board by the attendant, and partly because oily dirt is not moved by a current of air. The blast should be followed by a careful wipe-over by an intelligent human being armed with a piece of dry soft rag. Waste is not to be recommended, as it leaves fluff and loose strands lying about. In applying an air-blast particular attention should be paid to resistance frames and other inaccessible parts. It is not desirable to have the pressure of the air higher than 60 lbs. per square inch, as cases have come within our knowledge where mica insulation has been stripped away by too great a blast of air. Where it is impossible to draw links in order to make a certain part of the board "dead," a feather brush mounted on an insulating handle may be used on systems at ordinary pressures of supply.

On many boards oil-break fuses are used, which have an occasional trick on breaking of distributing their oil fairly impartially over the surrounding apparatus. Oil is in itself an insulator, and, therefore, although it looks untidy, it is safe. But a streak of oil is a resting place for all passing dirt, and if it is not soon removed the insulating properties of the board may be greatly reduced. On any board where oil is used, care must be taken that none gets upon insulation composed of rubber or wax, as they become deteriorated by its action.

It may not, perhaps, be out of place to draw attention at this point to the careful examination of fuses. Metal-strip fuses, it is notorious, deteriorate in course of time, and should be systematically replaced. A rough method of checking their behavior is to test their temperature when on full load. When a particular fuse has an unusually high temperature it should be marked for removal at the earliest possible opportunity. Quite apart from this, however, a fuse should not be allowed to remain in use for more than a year's running. Where oil-break fuses are used the level of the oil in them should be examined daily. Some types are constructed to break in air, the fused ends being then plunged in oil; other makers prefer to make the arc in the oil itself. In either case the oil must not get too low. Metal vapor bridges a very wide air space, and hideous results may follow from the improper breaking of a fuse.

It is an unfortunate phenomenon in central station practice that many parts of the plant, originally put up as temporary plant, become by their good conduct permanent institutions. This is very much the case with switchboards, where opportunities of reconstruction are rare. Teak—a very slow burning wood—has been used for this purpose. It is oily, and so resists moisture. It should, however, be watched with an anxious eye by the engineer-in-charge. Asbestos, from some points of view, is better—it will not burn. But it absorbs any moisture it can find, and hence its insulating properties are diminished. If asbestos is used, it should be painted with some insulating varnish to remove this danger. The same remark applies to slate, whose enamel has been damaged by an arc. Precautionary measures of this description are worth any amount of brilliant evolutionary operations with burning switchgear in order to save the lights.

One of the functions of the switchboard is to register the amount of energy generated and distributed. The switchboard attendant is supposed to take a record every quarter or half-hour of his indicating meters, and to register the readings of his integrating meters at the end of his shift. If these meters are out of order, the proceedings become a solemn and arduous farce. The engineer should at least know how to adjust the zero of his indicators, and should do it. He should also check his machine meters against his feeder meters, one voltmeter against another, pretty frequently, and report faulty instruments. He should time his integrating instruments against his ammeters, and make sure there are

*From the "Electrical Review." London.

no shunt current errors, friction losses, and so on.

It is, of course, impossible to enumerate all the points which require supervisory routine. Different types of switchboard develop various tendencies to failure, which have to be particularly watched. It is, however, safe to say that the engineer-in-charge will find that a conscientious scrutiny of his switchgear from time to time will amply repay him.

MOTOR DRIVEN PUMPS.

ARTICLE I.

BY W. H. WAKEMAN.

As power can be transmitted by means of electricity more conveniently than in any other way, the application of this form of transmission has become an interesting and useful part of present day engineering, therefore a few illustrations of pumps driven in this way will be presented for the benefit of all concerned.

Fig. 1 illustrates a triplex power pump driven by an inclosed motor geared to the pump shaft. The motor runs at a comparatively high speed which is reduced at once by the first change of gears. The shaft carrying this large gear is carried on the rear of frame to the right, where another change of gears still further reduces the speed. The great objection to gears is the noise they make when all are made of iron, but this is overcome by using pinions made of rawhide.

Fig. 2 is an end view of the same kind of pump, but the motor drives the first shaft 2 by a belt running over an idler 3 by means of which any desired tension of belt may be secured. This idler is pivoted at 4 so that by means of the nut 5 it can be drawn downward at pleasure. One pair of gears is used but the machine is practically noiseless in operation.

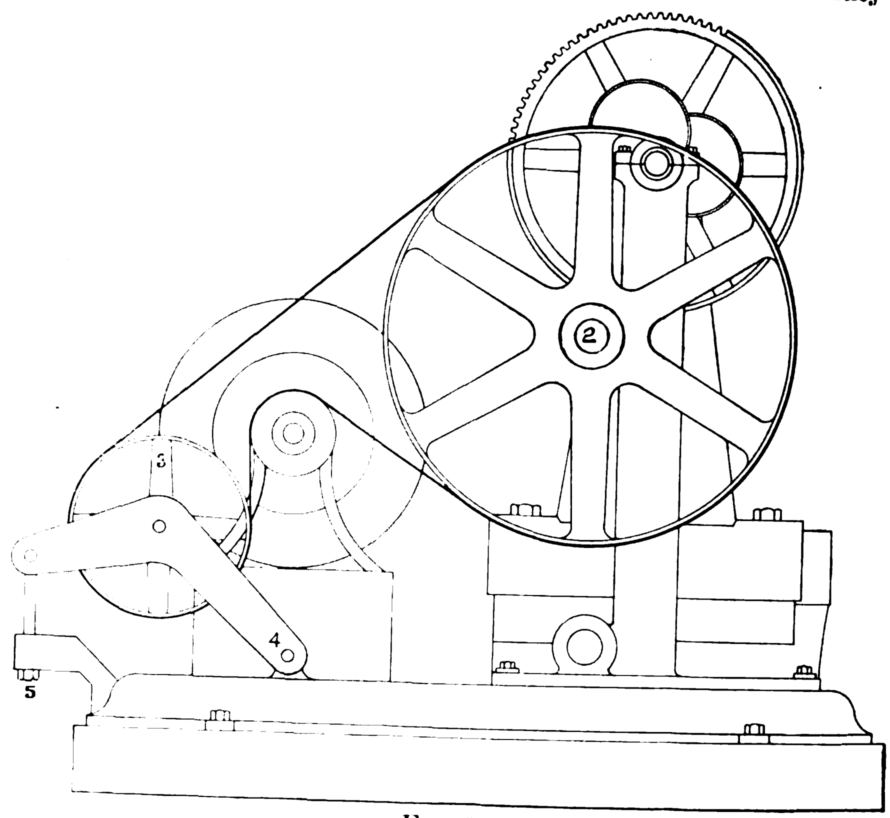

FIG. 2.

In this illustration and others which follow, the gears are not supplied with teeth over their whole circumference as it was not considered necessary.

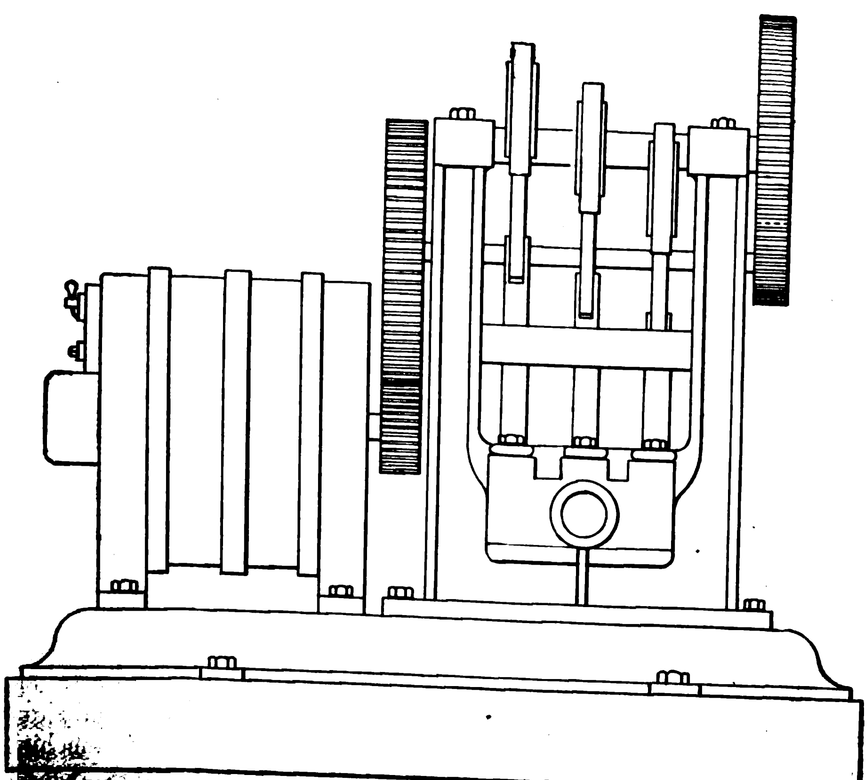
FIG. 1.

The reader will readily understand that wherever any teeth are shown it is assumed that they are cut for the entire gear.

Let us consider briefly the advantages gained by the use of either geared or belted pumps as shown. They can be located in the most convenient place for boiler feeding, regardless of the position of engine or line shafts. Have you ever discovered a power pump located in some inappropriate place, and on investigating the cause for its inconvenient location found that it was because it could be driven from a line shaft? On every other account it is out of place, as the suction pipe must be run to it, and the discharge carried from it to the boilers.

It always runs at the same speed, consequently when the boilers have enough water, the fireman or water tender must leave his boiler room and stop the pump until more is wanted, when he must make another journey for the purpose of starting it again. Under such conditions it cannot be expected that a steady water level will be maintained, as it is not practical, consequently there is danger of the water being too low at one hour, endangering the boilers, and too high at another time, endangering the engine.

Where either of the pumps shown in Fig. 1 or Fig. 2 are adopted the case is very different. The machine is located where the suction pipe can be short and direct, and the water delivered to boilers with the least possible friction. It will be found either directly in the boiler room, or else in another close by where it will not be covered with dust and ashes. Here the fireman can give it all

due attention without interfering with other duties, and as it is driven by a variable speed motor, the amount of water delivered can be gauged to meet the requirements of the boilers, thus maintaining a steady water level at all times, securing the best results so far as both engine and boilers are concerned. All of the advantages are due to the fact that it is not necessary to locate the pump where it can be driven from a shaft that was really installed for other purposes.

Water under pressure is wanted for other duties to which these pumps may be applied. In the plant where the writer has the honor to be chief engineer, steam is carried about 200 feet to run a pair of duplex cold water pumps. These take water from street mains and give a pressure sufficient to carry it to the top floor of a large building. As electricity is generated for lighting and power purposes, it is plainly a better plan to run a wire to this point and operate a motor driven pump on this service.

In other places water is wanted for hydraulic elevator service, either using a closed tank in the basement in the upper part of which air under pressure is maintained to prevent shocks and jars due to a solid body of water, or else carrying the water to an open tank on the roof.

In either case the amount of water delivered just equals the demand, as the speed of pump is controlled by apparatus which starts the pump when water is wanted, and stops it when a given pressure is secured, or when the water level in tank rises to a certain height.

Another point to be considered is that in some public buildings there is no shafting from which to drive a power pump, but electric current can nearly always be secured from street lines, if none is generated on the premises.

It is absolutely necessary that all machinery in such buildings be operated with the least possible noise, as otherwise the occupants will be disturbed while at their regular work. Noises that are never noticed in a power station or a manufacturing plant become an intolerable nuisance in public buildings.

Electric transmission of power and the use of motors constitute satisfactory apparatus for this exacting service, and the three plungers shown deliver a continuous stream of water, which is another point worthy of consideration.

Fig. 3 illustrates a horizontal duplex power pump driven by a motor so located that it occupies space that would otherwise not be used for any useful purpose. This kind of pump always delivers its full capacity at given speed, as there is no chance for one piston to give short strokes as in a steam pump. As the cranks are set at right angles, a continuous flow of water is secured, but for still further security against shocks and jars, an air chamber is placed on the suction, and another on the delivery pipe.

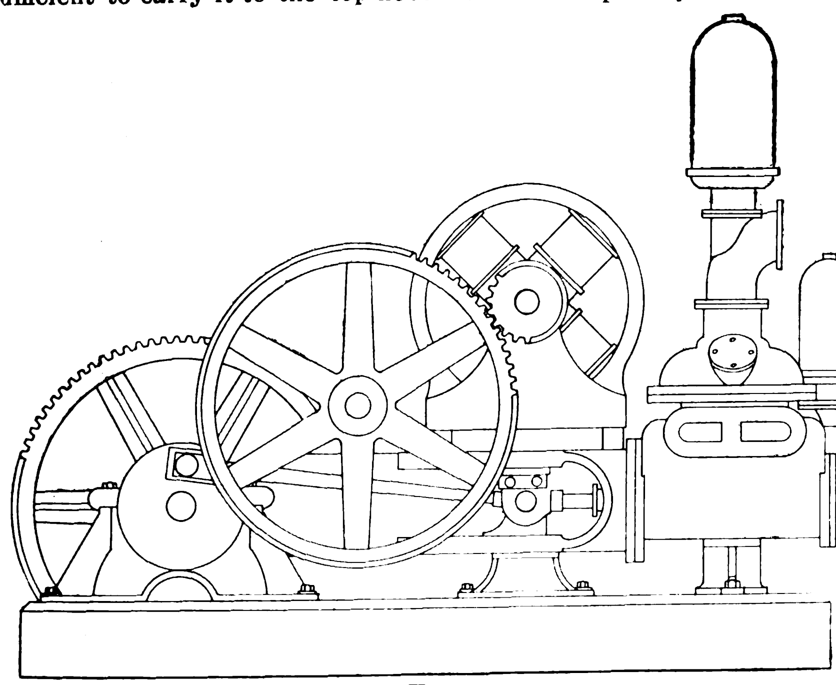

Fig. 3.

Suitable sizes of this pump may be used wherever the two former kinds are satisfactory, and they will be found available where low ceilings prevail, as they require but little head room.

Electric cars are being used for the shipment of wheat from points which hitherto have had no market except by trucking into Portland and Oregon City.

CARS—THEIR EQUIPMENT AND MAINTENANCE.*

BY JOHN ALDWORTH,
General Manager Nottingham Corporation Tramways.

"Cars, their equipment and maintenance," is undoubtedly one of the most important matters with which tramway managers and their staffs have to deal, as this is the actual and visible source from which the revenue of the undertaking is derived. The average passenger does not trouble himself much about such matters as the design or equipment of the power station, and provided there is always sufficient power to run the car on which he is traveling, rests satisfied that everything there is as it should be; but let the car be not quite to his liking as regards accommodation, especially when asked to close up and make room for "just one more, please," or the temperature inside does not exactly suit his particular ideas on the subject, he is often very much in evidence; whilst, for want of something else to grumble at, he occasionally enlarges upon the way in which he would build and run cars if he had anything to do with the matter beyond, as he is fond of telling the tramway employes, "having to help to pay for them."

The subject is also a very large one, and no attempt will be made in this paper to treat it at all fully, as to do so would be to raise more points than could reasonably be dealt with in a paper of this description, or discussed in the limited time at our disposal. The writer, therefore, proposes to touch only upon a few of what he considers to be the most important features, and wishes it to be understood that his observations are chiefly a description of the methods in operation on the Nottingham system, the result of some 11 years' experience in the working of that and other electric tramway undertakings; also, that it is not intended to lay down rules and regulations upon matters which have to be dealt with in accordance with the local or special conditions pertaining to each separate undertaking, but only to provide a basis for discussion and comparison with the methods in operation on such undertakings.

Design of Cars.—Cars should be of a design and size most suitable for the safe and expeditious handling of the particular class of traffic to be dealt with. For the traffic in the streets of large towns, single-truck cars carrying from 50 to 56 passengers are, in the writer's opinion, the most suitable. From the passengers'

*Paper read before the Municipal Tramways Association of Great Britain, September 28, 1904.

point of view, it gives a more frequent and a quicker service, while from an operating point the car is more easily handled, and can work its way through the ordinary traffic of the streets with much less risk of accidents. For dealing with a long distance and varying traffic over suburban lines, the large bogie car carrying from 80 to 100 passengers has its advantages.

Of the reversed and ordinary type of staircase, both have their advocates. For insuring the safety of passengers, protecting motormen and conductors from the vagaries of the English climate, and utilizing all the space possible for seating accommodation, the reversed type is undoubtedly the best, the chief drawback being that it to some extent obstructs the motorman's view of the traffic on one side; the writer has overcome this difficulty by inserting a small sheet of ½ inch plate glass in the riser of the staircase level with the motorman's head. This device has now been in use for a considerble time, and has proved very effective.

The efficient ventilation of the car is one of the things that until quite recently has not had sufficient attention devoted to it, and many of the earlier cars leave much to be desired in this respect. To remedy this defect as much as possible, the writer has had the four corner-side ventilating windows, which were originally hinged at the bottom, pivoted vertically at the center, so that the end of the ventilator nearest the platform swings outward and the other end inward, thus giving two openings on each side of the car through which a supply of fresh air is admitted at the front, above the passengers' heads, the foul air being forced out through the two corresponding openings at the rear end. The size of the openings can be regulated according to the state of the weather. With cars having rheostats fixed inside under the seats the question of ventilation becomes still more important, and for this reason, if no other, the writer considers all rheostats should be fixed in some outside position.

A folding step is being given a trial in some towns. The writer, however, is unable to give particulars of this device, but hopes something will be said on this subject by the members present who have been trying it. The writer does not propose to touch upon such controversial subjects as top-deck covers, dry seats, wind shields, route indicators and lifeguards, which for some time past have been so much in evidence.

Motors.—To insure a satisfactory service, it is necessary that cars should be equipped with motors designed to meet the varying conditions of the particular system they have to operate, and be capable of developing sufficient power to enable them to climb the steepest gradient thereon, without being unduly overloaded; as, although the initial cost may be lower and the average consumption of current per mile kept a fraction less with a smaller motor; the additional cost of repairs will more than counterbalance this, to say nothing of the risk of breakdowns on the road, with its consequent interruption of traffic. Given a properly-designed and sufficiently powerful motor, the important thing is to see that it is well taken care of. This can only be done by having it systematically inspected and maintained in the most efficient condition.

The writer has tried several methods of inspection and reporting upon the condition of the car motors, also of carrying out the repairs, and the following system has been adopted as the result thereof: The commutators, brushes and brush springs are examined nightly, and where any commutator shows signs of undue sparking or heating it is carefully examined by the night foreman, and if no cause for it can be discovered it is cleaned, and the car again put into service; instructions are given to the chief motor inspector to test the car on the road during the following day, and if then found to be working unsatisfactory in any way, it is sent into the works to be thoroughly tested and the defect put right. Armature and motor bearings, with their lubricating boxes, are also examined nightly, and any defect discovered is reported to the night foreman, who in every case uses his discretion whether such can be efficiently dealt with by himself, or whether the car shall be kept in for it to be dealt with by the day staff.

(*To be continued.*)

THE FLEMING KUMMETER FOR MEASURING WAVE LENGTHS IN WIRELESS TELEGRAPHY.

(From our London Correspondent.)

By the courtesy of Dr. J. A. Fleming, of the Pender Electrical Laboratory at University College, London, we are enabled to give the accompanying diagram of his new apparatus known as the Kummeter, and some descriptive notes of same. This apparatus was devised by him for measuring wave lengths in connection with Hertzian wave wireless telegraphy, it being a matter of considerable importance to be able to determine the frequency and wave length of the waves sent out by any given transmitting

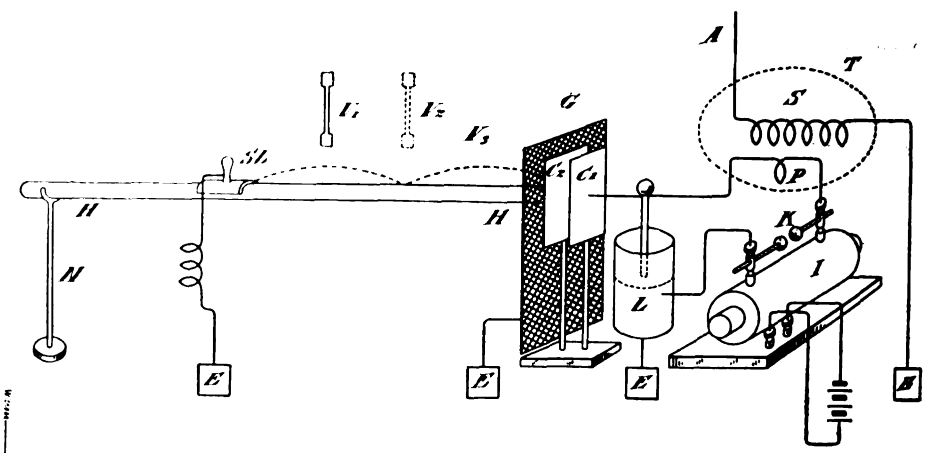

Diagram of the Fleming Kummeter for Measuring Wave Lengths in Wireless Telegraphy.

arrangement. SL is a sliding metal saddle connected to the earth. The helix is connected at one end to one plate C_2 of an air condenser, the other plate C_1 being connected to the wireless telegraph transmitting apparatus. A screen of wire gauze G, with a hole in it, protects the helix from electrostatic influences.

The transmitting plant is shown on the left hand side, I is the induction coil, L the Leyden jar or condenser, T being the transformation coil, A being the aerial wire.

The measurement consists in adjusting the distance of the saddle SL so that one complete wave of a stationary wave is produced on the helix. This is detected by the use of a vacuum tube filled with Neon V_1, which is held in different positions above the helix; the saddle must be so adjusted that when the tube is held half way between the saddle and the condenser it does not glow, but when it is held one-quarter of the way or three-quarters of the way it glows brilliantly. The distance from the saddle to the condenser plate is then one complete wave. The

velocity of the wave along the helix can be calculated from its inductance and capacity, and hence the frequency of the spark in the transmitting apparatus becomes known.

If this frequency is divided into the velocity of light, reckoned in feet, it gives the wave length in feet of the wave radiated from the associated aerial, provided that the aerial radiating wire has been tuned to be in resonance with this oscillating circuit.

Prof. Fleming had one of his Kummeters on exhibition at the recent meeting of the British Association for the Advancement of Science at Cambridge, and if any of our readers desire to have a fuller account of the apparatus, they will find it in the *Philosophical Magazine* for October, in an article entitled "Electric Waves on Spiral Wires." It may be added that the instrument also provides the means of measuring small inductances, and also the frequencies in oscillating circuits, which are much higher than those which can be determined by photographing the spark.

PERSONAL MENTION.

Mr. Y. Shinto, B. Sc., of Tokio, Japan, is now here. He will make a somewhat extended tour throughout the country in order to secure data, which will permit of the preparation of an exhaustive report on electrical matter for submission to the Japanese Government. Mr. Shinto is a brother-in-law of Prof. I. Fujioka, of Tokio, who is well known in the United States.

Mr. B. L. Burdick, electrical engineer, for ten years associated with the electrical business in Milwaukee, Wis., has become a partner of the recently organized Keelyn Electric Company of that city.

Mr. Charles Sheets, of Oshkosh, Wis., will go to Mazatlan, Mexico, where he will take charge of an electric light plant.

Electric Supplies Wanted.

The Lincoln Ice & Cold Storage Company, Lincoln, Neb., expects to erect a storage plant of about 350,000 cubic feet capacity and will require dynamos, electric pumps and elevators.

The Protection of Commerce.

Notwithstanding peace tribunals, war remains the ultimate resort of national disagreement, writes Michael White in *The Four-Track News*. The motive of it, however, is no longer for the subjugation of races, or the possession of thrones, but the protection or extension of commerce. Hence as we pass the threshold of the age of commerce, we may remark as not without a significant bearing upon the future that, monsters as are our battle ships, the leviathans of the deep are our merchantmen, competing, not with torpedoes and shells, but in speed, capacity and economy.

If some there are who say the battleship has reached its highest development, to give place to fleets of smaller craft, no voice is heard venturing the same opinion of our merchantmen.

Hence it is our merchant vessels rather than our battleships which typify an advance in the direction of universal peace and civilization.—Editorial from the Chicago "Evening Post."

Favor an Alliance with Harvard.

A majority of the trustees of the Massachusetts Institute of Technology are reported to be in favor of an alliance with Harvard.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCT. 4, 1904.

Electric Railways and Appliances.

771,334. Third-Rail Insulator. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to the General Electric Company. Filed May 31, 1902.

771,423. Trolley-Wheel. Joseph N. Drake, Cincinnati, O. Filed Dec. 15, 1903.

771,472. Trolley-Harp. John Hensley, Huntington, Ind. Filed May 5, 1904.

771,476. Car-Fender. Frederick R. Keith, Randolph, Mass. Filed Feb. 3, 1904.

771,510. Safety-Coupling for Electrical Wires Connecting Railway-Coaches. John G. Thomas and David E. Lewis, Scranton, Pa. Filed Oct. 2, 1903.

771,533. Electric Railway. Alexander Churchward, New York City, assignor to the General Electric Company. Filed Feb. 20, 1903.

771,545. Car-Fender. Jacob Happel, Middletown, Ky. Filed Dec. 13, 1902.

771,563. Trolley-Catcher. William M. McArthur, Lockport, N. Y. Filed May 16, 1904.

771,785. Electric-Railway System. William G. Lowrie, New York City, assignor to the International Electric Traction Company. Filed June 21, 1901.

Electric Lights and Appliances.

771,240. Socket for Electric Lamps. Edwin R. Gill, Yonkers, N. Y. Filed June 27, 1903.

771,295. Lighting Electric-Trolleys. Walter Burling, Grand Rapids, Mich. Filed July 11, 1904.

771,569. Socket for Incandescent Electric Lamps. George B. Painter, Schenectady, N. Y., assignor, by direct and mesne assignments, to the General Electric Company. Filed Oct. 9, 1899. Renewed Sept. 22, 1900.

Electrical Machinery and Apparatus.

771,237. Reactance-Coil. John J. Frank, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 2, 1903.

771,238. Multiphase Transformer. John J. Frank, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 6, 1904.

771,239. Electric Switch. Ernest L. Gale, Sr., Yonkers, N. Y. Filed Feb. 8, 1904.

771,246. Alternating-Current Motor. Arthur W. Henshaw, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 11, 1903.

771,260. Field-Magnet Core. Charles R. Meston and Herbert I. Finch, St. Louis, Mo., assignors to the Emerson Electric Manufacturing Company, same place. Filed March 21, 1904.

771,266. Electric Meter. William H. Pratt, Lynn, Mass., assignor to the General Electric Company. Filed Feb. 16, 1903.

771,284-285. Dynamo-Electric Machine. Charles P. Steinmetz Schenectady, N. Y., assignor to the General Electric Company. Filed April 30, 1900, and Jan. 25, 1904.

771,293. Alternating-Current Induction-Motor. Andrew E. Averrett, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 26, 1903.

771,299. Apparatus for Regulating Electric Currents. Reginald C. Clinker, Rugby, Eng., assignor to the General Electric Company. Filed Jan. 24, 1903.

771,307. Means for Protecting Electric Conductors. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 9, 1903.

771,313. Electric Switch. Charles E. Lombard, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed Sept. 19, 1903.

771,314-786. Phase Transformation. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company. Original application filed July 31, 1900. Divided and this application filed April 5, 1902.

771,317. Alternating-Current Transformer. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 31, 1903.

771,323. Iron-clad Electromagnet. David Perret, Neuchatel, Switzerland. Filed April 21, 1904.

771,325. Collector-Ring. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company. Filed May 23, 1901.

771,351. Electrical Hoisting Apparatus. Eugene B. Clark, 2d, Chicago, Ill., assignor to the Otis Elevator Company. Filed Jan. 23, 1902.

771,436. Time Circuit-Controller. Robert A. Moore, Huntsville, Ala. Filed Sept. 10, 1903.

771,468. Air-Cooled Electric Machine. Leo Falk, Baden, Switzerland. Filed Nov. 18, 1903.

771,518. Electric Apparatus for Felling Trees or Sawing Wood. Thomas O. Wilson, Little Rock, Ark. Filed Jan. 30, 1904.

771,523. Circuit-Controller for Electrically-Propelled Vehicles. Bert Aikman, Chicago, Ill. Filed Aug. 31, 1903.

771,683. Electric Ignition Device for Internal Combustion Motors. Charles W. Svenson, New Britain, Conn., assignor to the Corbin Screen Corporation, same place. Filed June 17, 1903.

771,739. Machine for Dressing Electros, Zincs, or Half-Tones. Frederick Murphy, Peoria, Ill. Filed June 1, 1903.

Telephones and Telephone Apparatus.

771,343. Telephone. Klas Weman, New York City. Filed June 23, 1903.

771,548. Telephone Call-Register and Time-Indicator. Edward K. Hertford, Washington, Ind., assignor to the Automatic Monitor Company, Toledo, O. Filed Jan. 25, 1904.

Miscellaneous.

771,235. Automatic Fire-Alarm Transmitter. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, same place. Filed Jan. 20, 1904.

771,249-250. Apparatus for Electric Heating. William S. Horry, Niagara Falls, N. Y., assignor to the Union Carbide Company same place. Filed June 28, 1904.

771,259. Electric Fixture. George L. Martin, New York City. Filed Feb. 2, 1903.

771,274. Electric Brush. Albert T. Sanden and Victor Sence, New York City. Filed Feb. 27, 1904.

771,297. Insulator. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, same place. Filed May 16, 1903.

771,400. Electric Programme-Clock. Edward E. Stone, Portland, Me. Filed March 14, 1904.

771,424. Electric Heater. Cassius M. F. Fisk, Napoleon, O. Filed March 5, 1904.

771,498. Electric Battery. Isaiah L. Roberts, New York City, assignor to the Economic Electric Company. Filed Oct. 14, 1903.

771,547. Thermostatic Finger-Piece for Push-Buttons. Willis E. Harmon, Mechanic Falls, Me. Filed Dec. 26, 1903.

771,676. Telegraph Call System. Jesse S. Snead and William O. Ballard, Atlanta, Ga. Filed March 17, 1904.

771,710. System of Electrical Distribution. Rufus N. Chamberlain, Depew, N. Y., assignor to the Gould Storage Battery Company, New York City. Filed March 19, 1903.

771,748-749. Electric Time-Alarm and Burglar-Alarm. William H. Robins and John F. Jacoby, Minneapolis, Minn., assignors to the American Bank Protection Company, same place. Filed April 7, 1903. Renewed Jan. 25, 1904.

THE TELEPHONE WORLD.

Extension Work by Independent Companies.

Fifty thousand dollars to be spent yet this season for wire in building toll lines and a quarter of a million to be used in building toll and local lines next spring is the immediate outlay decided on by the directors of the Indianapolis, Ind., Telephone Company, and the New Long Distance Telephone Company. An immense amount of work is to be done before January 1 in Indianapolis aside from that for which the $50,000 is appropriated.

"The Indianapolis Telephone Company," said S. P. Sheerin, president and general manager of the two companies. "has been spending a great deal of money all summer. It has expended in the neighborhood of $100,000 between the 1st of April and the 1st of October on the local plant.

"The business on all our lines—both local and long distance—is growing so rapidly that we find it very difficult to keep up with it. Notwithstanding all the extensions that we have made this summer we are still very far behind, and have nearly a thousand people on the waiting list here in Indianapolis.

"Indianapolis is a growing city, and we expect, of course, to keep pace with its growth. In a comparatively short time now we shall have completed our cable extensions in the city for this season, and by that time we shall be able to give service to a great many of our friends who have been waiting a long while.

"The growth that we have experienced in this city has been almost equalled by the growth of the other Independent telephone companies in the State, and this growth is making a very great demand on our long distance service. Beginning in the early spring we will undertake the construction of a large number of new lines, which will involve at least a quarter of a million dollars for next year's building season."

The Keystone Telephone Company reports net earnings of $91,973 for the quarter ended September 30. This compares with $61,156 for the corresponding quarter last year, $78,960 for the March, 1904, quarter, and $86,241 for the June, 1904, quarter. For 9 months ending with September of this year the company has made total net earnings of $257,124. which compares with total profits of $232,515. for the entire 12 months of 1903.

Independent managers say the work of the past year that has led up to the formation of the organization at St. Louis is the most important work ever done in the history of the Independent movement.

The Iowa Telephone Company has decided to renovate its lines and appurtenances at Dubuque and will spend in the neighborhood of half a million dollars in the reconstruction of the lines and the building of a new central building.

The Holt Telephone Company of Holt, Mo., has filed a statement increasing its capital stock from $10,000 to $30,000.

The $250,000 bond issue of the Home Telephone Company, of Dayton, O., has been taken up by the Dayton Savings & Trust Company.

Want Independent 'Phones.

After a spirited debate between the members of the Millcreek Valley Business Men's Club and representatives of the Cincinnati, O., & Suburban Telephone Company, regarding the recent increase in toll to the northern end of the valley, the club voted to have all instruments removed from Carthage, Elmwood Place and St. Bernard in that State.

The club will petition the councils of the various villages to grant telephone franchises to Independent companies.

The annual meeting of the stockholders of the Federal Telephone Company, was recently held at East Orange, N. J. R. W. Judd, treasurer of the company, represented the stockholders. It is the plan to continue the same organization for such period of time as may be required to work the affairs of the company around to final solution and get the finances on a permanent basis. The statement of the company for the year will be much better than the statement of the preceding year.

The rural telephone is fast becoming one of the most popular of the modern conveniences in Scott County, Ia. Where a few years ago it was impossible to reach the farm houses without a drive of many miles, to-day residents of the city, and the business men in particular, may remain in their headquarters and converse over the wire to hundreds of residents in the country. Three new lines have lately been opened up out of Davenport by the Iowa Telephone Company.

The Telephone & Telegraph Company of New Jersey was incorporated last week at Trenton, with a capital stock of $250,000, to construct and operate lines of electric telephone and telegraph. The incorporators are Alfred E. Holcomb, Harry W. Brigham, George H. Minster, Samuel S. Moore and Robert Bain. The principal office of the company is at 8 Erie street, Jersey City, which is the office of the New York & Jersey Telephone Company.

Arrangements are being made by the Northwestern Telephone Exchange Company in Minneapolis, Minn., to establish a central exchange for all long distance wires on the East Side to handle all the long distance telephone business of the Twin Cities.

The farmers living in the vicinity of Mansfield, S. D., have organized what will be known as the Farmers' Telephone Company. The company will construct a rural telephone line from that place. The officers of the company are: President, John Harrington; secretary, George Woodford; treasurer, Charles Granger.

The Elk Telephone Company will extend its lines to Falls Creek, Pa., where it will connect with the Summerville Telephone Company's line. This will enable subscribers to the Summerville line to talk with people in Brockway ville and in Elk County.

The plan of establishing public open air automatic telephone pay stations is about to be tried by the Cuyahoga Telephone Company of Cleveland, O. The apparatus will be merely a small box, about the size of a fire alarm box. The public may make use of the boxes by the deposit of a nickel.

Farm Telephone System in Michigan.

The farmers of the townships of Newton and Leroy have organized a co-operative company for maintaining a system of telephones from farm house to farm house, with the office and switchboard at Newton Center. All of the farmers of those townships have entered into the scheme. To avoid expense the wires will be run on top of the fences, poles only being used where the wire crosses a road. The wires can be taken care of at much less expense and will not be broken down by wind storms.

It is announced that the Raleigh, N. C., Telephone Company will construct at once a line to the town of Clayton. It is not to be a toll line as most of the other lines are that have been built out of Raleigh by other companies, but the business men and others of Clayton will pay so much per month or year for the lines, and use them at will, whereas other lines charge their patrons say 15 cents for every three minutes' talk. A prominent business man of Raleigh, in speaking of advantages of the new line to Clayton and the great benefit the Raleigh Telephone Company is to the city, declared that this is another instance in which the home company protects the people against exorbitant rates, a protection that should be appreciated substantially and evidenced in the liberal patronage accorded by the people.

The Wegner-Hall Construction Company of Detroit, Mich., wishes to install a telephone exchange in Delray, and has asked the village council for a franchise. The Detroit concern proposes to install a plant capable of taking care or 500 subscribers, and intends to charge the following rates: Business, $30; residences, on a two-party line, $24; on a four-party line, business places, $24; residences, $20. These prices are for local connections. With Detroit connections the prices would be: Business places, $40; residences, $30; two-party line, business, $24; four-party line, business, $20; residences, $18.

The Hudson River Telephone Company has sold out its interest in Fulton, Hamilton and Montgomery Counties, N. Y., excepting in the city of Amsterdam, to the Glen Telephone Company, which operates in the three counties. The Glen concern now comes under the trunk line system of the American Telegraph & Telephone Company.

The Oil Belt Telephone Company of Norwalk, O., which was incorporated at Columbus with a capital stock of $25,000, will build exchanges at Cygnet, Portage and Jerry City, in Wood County, with connections and free service with the Independent exchange at Bowling Green. It is estimated that over 150 miles of wire will be strung and 500 'phones installed.

The automatic system now in use in Denver and Colorado Springs will be introduced at Cripple Creek. The improvements will cost approximately $100,000 in the Cripple Creek district.

The Browning Telephone Company, Browning, Mo. Capital stock, $1,070. Incorporators: S. L. Gibson, F. M. Haymaker, G. G. Herman and others,

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bucksport, Me.—The new Bucksport Lighting Company has been organized with a capital of $15,000. It proposes to do a general electric lighting and gas business. H. L. Cram, of Portland, is president.

Clinton, N. Y.—This town has voted in favor of issuing $7,000 electric light bonds.

Coffeyville, Kan.—At a recent meeting of the council an electric light franchise passed its first reading, granting W. Nees, of the Union Traction Company, a five-year franchise, and five months in which to put in a plant.

Dillsboro, Ind.—William E. Swarthout is back of a movement to build an electric lighting plant here.

Enid, Okla.—The Enid Electric & Gas Company has been incorporated with a capital of $200,000. L. D. Turner and R. F. W. Holder, of Belleville, Ill., are interested. The company is in the market for some new boilers. H. H. White, of this city, is engineer.

Grand Rapids. Mich.—The Thornapple Electric Company has made application to the common council for a lighting franchise. The matter is now under discussion by the city council.

Jefferson City, Mo.—W. N. Horner, representing a Chicago syndicate, who recently purchased the Jefferson City electric light plant for $80,000, proposes to enlarge and rebuild the plant, making it a first-class one.

Kirkland, N. Y.—At a special election held recently the proposition to bond this town for $7,000, to construct an electric lighting system was carried.

Laurens, S. C.—This city will issue $40,000 bonds, $10,000 of same to be used for electric light purposes.

Little Rock, Ark.—The electric light service here is to be improved.

Millersburg, Mich.—This town wants an electric lighting system.

Monroe, Ga.—At the instance of the chairman of the board of trade of this city a meeting of the citizens has been called to consider the question of waterworks, electric lights and public schools.

Moundsville, W. Va.—The council here is investigating the cost of better electric lights.

Mount Union, Pa.—The Johnstown Electric Light Company has offered to build and equip an electric light plant here for $12,000,

Newport, N. H.—The Newport Electric Light Company has purchased the electric light plant at Sunapee, and as soon as a line of wire can be put up the electricity for the Sunapee lights will be furnished from the Newport plant.

Ontario, Wis.—Herman Timmerman has commenced preparations here for boring a tunnel a quarter of a mile long through solid rock to develop a water power of about 300 hp., and with which it is intended to operate electric light plants at this place, Norwalk and Wilton.

Ottumwa, Ia.—The Black Hawk Electric Company has been awarded the contract for installing an electric light plant.

Paducah, Ky.—Engineer H. H. Humphrey, an electrical expert of St. Louis, has been here inspecting the city electrical plant, seeing what was required to furnish the number of lights needed, and drawing plans for enlarging it next year.

Santos, Brazil.—An electric light station is to be established here.

Sheridan, Ill.—The village board is considering the proposition to have electric lights.

St. Joseph, Mo.—At the recent city council meeting an ordinance was introduced by Councilman Barkley appropriating $76,869 for the construction and equipment of a new electric light plant.

Telford, Pa.—A charter has been granted to the West Telford Electric Light & Power Company for supplying that borough and adjacent territory. The subscribers are Henry J. Wambold, West Telford, and Morris A. Clymer and Mame E. Clymer, both of Sellersville.

Topeka, Kan.—The electric light company is asking for a 30-year lease of life.

Tremont, Ill.—The owners of the electric light plant here expect to sell out. It is probable that Pekin parties will want to wire out from that village and furnish the power from Pekin.

Wichita, Kan.—The Citizens' Electric, Heat, Light & Power Company has asked the council for a franchise to use the streets for the purpose of installing a system of electric lights.

Woodbury, Pa.—A proposition is on foot here to have an electric lighting plant.

STREET RAILWAYS.

Baton Rouge, La.—The survey for the electric line, which it is proposed to build between this city and New Orleans, has been completed, and the engineers found that the line, as laid, is exactly 106 miles and that the distance can easily be cut to an even 100 miles.

Bolton, Conn.—The residents of this place want a trolley line.

Centralia, Ill.—The work of building the Southern Illinois Electric Railroad will be commenced shortly.

New York City.—About 100 miles of the Long Island Railroad system will be operated by electricity early next spring. The result will be a quicker and better train service on the Atlantic Avenue, the Rockaway, the Far Rockaway and the Manhattan Beach divisions of the railway. This is only one step in a big transformation in the motive power of what is known as the short haul train service of the road that will ultimately make it possible for a person to take a train at the Pennsylvania station at 33d street and 7th avenue, and ride without change of cars or motive power to Manhattan Beach, Rockaway Beach, Far Rockaway, Arverne or intermediate points.

Parkesburg, Pa.—The newly chartered Oxford, Cochranville & Parkesburg Electric Railway Company has decided to issue bonds in a sum not exceeding $300,000. The southern terminus of this road is to be in Oxford. It will extend through the villages of Hayesville, Russellville and Cochranville and the townships of Lower and Upper Oxford, West Fallowfield and Highland, to this city a distance of about 14 miles.

Sandusky, O.—The management of the Sandusky, Norwalk & Mansfield Electric Railway Company is preparing plans and specifications for the machinery for the new power house to be constructed here, and is also advertising for bids.

Two Rivers, Wis.—It is now practically an assured fact that the electric line connecting this city with Green Bay will be built early next year. The Knox Construction Company of Green Bay will build a line from that city to Mishicott where connection will be made with the Higgins line, which will be built north from here. A franchise will not be asked for, it is announced, but the right-of-way will be purchased.

Warren, Ill.—H. B. Cook, of Chicago, is talking of building an electric road here.

Washington, Pa.—William Flinn and other capitalists have secured the rights of way for a trolley line between this city and Library.

Wilmington, O.—The Wilmington-Hillsboro Traction Company will build a line from this city to Hillsboro.

POWER PLANTS.

Eugene, Ore.—Notice was lately filed with the county clerk by the Willamette Valley Electric Railroad Company of its intention to appropriate from the McKenzie River 15,000 cubic inches of water, by miners' measure, under 6-inch pressure, to be used in generating power to operate all kinds of electrical machinery.

Phœnix, Ariz.—Charles M. Clark has announced the completion of negotiations for capital for the installation of his water power enterprise on Salt River, below the mouth of Cherry Creek. He expects to develop 8,000 hp. at a point only a few miles above the upper end of the Government Tonto basin reservoir.

Spokane, Wash.—The Spokane Power & Transportation Company is talking of installing a new power plant.

Yardley, Pa.—A power house and plant to cost $200,000 will be erected here by the Yardley & New Hope Trolley Company. This line is being built on a private right of way from New Hope to this city.

BIDS WANTED.

Burlington, Vt.—Sealed proposals in triplicate will be received until 12 M. October 25 for the installation of an electric lighting system, including interior wiring and fixtures, distributing system and electric current, at Fort Ethan Allen, Vt. Information furnished on application. The Government reserves the right to accept or reject any of the bids or any part thereof. Envelopes containing proposals must be indorsed "Proposals for electric lighting system at Fort Ethan Allen, Vt. Captain T. B. Lamoreux, Quartermaster."

Camden, N. J.—Sealed proposals will be received by Joseph Potter, chairman, for installing a complete electric lighting system at the Morris pumping station.

Lincoln, Neb.—Sealed proposals will be received by Thomas R. Pratt, city clerk, until October 18, for the purchase of poles, lines, lighting circuits, boilers, engines, feed water heater, boiler feed pumps, electric generators, switchboards, series alternating arc lighting regulators or transformers and arc lamps and constant potential transformers.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 12⅞@13c.; Lake 13@13⅛c.; casting, 12¾@12⅞c.

The Lyons Belt Railroad Company and the Bloomington, Clinton and Decatur Electric Railroad Company have been incorporated in Illinois.

The gross receipts of the Philadelphia Rapid Transit Company for September are said to have been $20,000 less than for the same period last year.

The Edison Electric Illuminating Company of Boston has declared a regular quarterly dividend of 2½ per cent., payable November 1 to stock of record October 12.

Judge Grosscup has granted a temporary injunction restraining the City of Chicago from interfering with the operation of the Union Traction Company's cars.

The directors and officers of the Syracuse (N. Y.) Lighting Company have been re-elected. Stockholders will vote shortly on increasing the number of directors from 13 to 15.

The United Traction Company of Albany, N. Y., has declared the usual quarterly dividend of 1½ per cent., payable November 1. Books close October 21 and reopen November 2.

The second quarterly rental dividend of 1½ per cent. will be paid Third Avenue Railroad Company (New York) stockholders October 21. Books close October 13 and reopen November 1.

The Milwaukee Railway & Light Company has declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable November 1. Books close October 20 and reopen November 2.

The Strowger Automatic Telephone Company of Chicago is said to have closed contracts last month which will net enough on the shares for the year to enable the payment of a 2 per cent. dividend for the year.

The Spies General Electric Manufacturing Company of New York, with a capital stock of $25,000, was incorporated at Albany on Monday. The directors are P. H. Spies, S. Heyden, David E. Aarons, New York.

Plans have been formulated for taking the Eastern Ohio Traction Company out of the hands of the receiver who has been operating it for some months. It is proposed to raise $375,000 by levying an assessment of $15 per share on the capital stock of the company.

The Baltimore Electric Power Company has been incorporated to construct the power and light plant of the Maryland Telephone Company. The authorized capital stock of the company is $2,500,000 divided into 50,000 shares of $50 each. Besides this the company is authorized to issue $7,500,000 bonds.

The remarkable strength of the refined copper market is puzzling the trade. It looks as if exports for October would exceed 25,000 tons. Competent authorities believe that the tremendous exports are going into consumption. An order for 10,000,000 pounds of copper will shortly be placed for export to Brazil.

An authority close to Electric Storage Battery management interests says that the company has recently received some very satisfactory orders, and that the business promised for the balance of the year makes it appear that the aggregate will compare favorably with 1903. The company in 1903 showed profits of $1,501,591, and after paying 5 per cent. dividends a surplus remained for the year of $789,156.

ELECTRICAL STOCK QUOTATIONS.

Name	Closing price Oct. 10.
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	154¼
Metropolitan Street Railway	120¼
Metropolitan Securities	82
Ninth Avenue	197
Third Avenue	129
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	59⅜
Public Service Corporation (New Jersey)	102
Philadelphia.	
Consolidated Traction of New Jersey	75½
Philadelphia Traction	98
Union Traction	56
Boston.	
Boston Elevated	154⅛
Massachusetts Electric Companies, com	13¼
do. do. do. pref.	55
West End Street, com	91
do. do. do. pref.	110½
Chicago.	
City Railway	178
North Chicago	71
Union Traction, com	7½
do. do. pref.	36
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	11⅞
do. pref.	50
Electric Boat, com	40
do. do. pref.	73
Electric Lead Reduction	½
Electric Vehicle, com	16¾
do. do. pref.	23¼
Westinghouse, com	165½
do. pref.	190
General Electric	171½
Boston.	
Edison Electric Illuminating	255½
General Electric	172
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	150
National Carbon, com	34
do. do. pref.	109
Philadelphia.	
Electric Company of America	9⅜
Electric Storage Battery, com	66¼
do. do. do. pref.	66½
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	138½
Western Telephone Company	13
New England Telephone Company	130¼
New York.	
American Telegraph & Cable Company	92
Commercial Cable Company	210
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	35
Consolidated Car Heating	64
Standard Underground Cable	200

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EDITORIAL NOTES.

The Railway Men's Convention.

There is no gainsaying the fact that the three meetings of street railway organizations, held last week in St. Louis, namely, the American Street Railway Association, the Street Railway Accountants' Association, and the American Railway, Mechanical and Electrical Association, will be productive of much good for all interested in street railway work, and for that matter, too, for those who have their money invested in the industry.

Several times in these columns we have advised the street railway men "to get together," and we are pleased to note that a movement was started in St. Louis to amalgamate the railway organizations so that all could work in harmony, or in the words of that Milwaukee veteran, Mr. John I. Beggs, "have a more complete organization of the entire body, and have proper officers to take charge of the great industry."

The proceedings of the meetings of the three associations will be found in this issue of ELECTRICITY, and several of the valuable papers read at the meetings will be published in later issues.

* * *

Guarding Against Collisions.

The opening day for the subway in this city is positively announced for next week—October 27—and it is gratifying to note that the officials say "that late experiments have proved that there can *never* be a collision on the underground road so long as the present block signal system is maintained."

Trains fully equipped during the past week were ordered to run into each other and in each instance they came to a dead-stop after passing the ends of the blocks with signals set against them. Trains thus stopped were perfectly dead, with all electric and air power shut off.

The success of these tests was admitted by the officials of the subway. The experiments were carried on for several days and in each instance, in addition to stopping the trains dead, the system by a signal notified the dispatcher's office that the train had attempted to run past the signals.

Motormen who attempted to run past the blocks on their own hook discovered this to their sorrow, being relieved of their trains for so doing. The rule has been made that for a motorman to have his car stopped by the safety device means instant dismissal. This is to make the men watch the signals and stop their trains and cars themselves.

In case of the motorman going suddenly insane or blind, or falling at his post from any reason, the block system will protect the passengers and prevent either rear or fore-end collisions.

The signal posts are set so close together in the tunnel that trains can be stopped instantly, even when the subway is running at its utmost capacity of a minute headway.

* * *

The New Ally of Japan.

Science and success are not synonymous expressions, yet they seem to represent the equivalent of each other with respect to the accomplishments of Japan in the Far East. In an interesting piece of fiction by Lord Lytton, entitled "The Coming Race," a great point is made of the development of society through the aid of science. Its influence physically, mentally and morally is clearly pointed out and the sum and substance of the interesting reasoning employed is to the effect that war will cease when the scientific ad-

vance and equipment of nations becomes so complete that to attack one another means to annihilate each other. In other words, when the dogs of war are loosed manned by men of science and operated according to the requirements of science, then it is a case of Greek meeting Greek. The interpretation of Japan's successes on land and sea can only be adequately comprehended in the light of scientific completeness. This completeness might be regarded from a series of standpoints, among which the most important would be hygiene, mobility and science. The first is largely a matter of medical science, and the hygiene of the army is preserved, according to authentic reports, by the advance corps of physicians acting in the capacity of bacteriologists, examining wells and streams before the soldiers are allowed to touch their contents.

This clearly proves Napoleon's proposition that an army travels on its stomach. In the matter of the second, mobility, or the science of rapid progress, much depends, which in its way is directly related to the electrical science.

The rapidity with which communications are established, signaling stations erected, telegraph wires run and all the miscellaneous methods of bringing each part of the army in touch with the other and the central directive body—this is, in a large sense, the measure of the mobility which exists. Japan has therefore taken to herself a new ally, not in a political sense, but in the manner pointed out. Her great ally is science. Science in food, in drink, in clothes, in accoutrements, in tactics and in methods of communication. According to the estimate and conclusion of an able military critic this system of scientific supervision and method has so improved Japanese strength collectively that a fighting force of a given number of soldiers expresses the ratio of nearly four to one in effectiveness as compared to Russia.

When the last records of the great war are written and the stataticians have had their way, after subtracting the elements of military genius in the generals and commanding officers and the indomitable fighting spirit of the men themselves, the residue, the balance due to applied science —this, we believe, will belong to the engineering corps, to skilled experts in civil engineering and electricity. What they have and will accomplish in building roads, building bridges, erecting fortifications and transporting supplies clearly leads to the proof that the greatest of all allies is not found in agreements and nations, but in the brains, the skill, the scientific perfection of one's own people.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

At the opening of a technical school at Dantzic, Germany, Emperor William gave to the work of manual training and scientific education a rank equal to that done in the old universities.

When the Pennsylvania Railroad Company completes its arrangements for its vast terminal facilities in New York City the electric locomotive will draw its trains through the Hudson River tunnel.

Dr. Louis Duncan, head of the electrical engineering department of the Massachusetts Institute of Technology, resigned on Saturday last. Dr. Duncan is electrical engineer for the New York Rapid Transit Commission and several railroad and telephone companies, and resigns to devote his entire time to these interests.

The Electrical Securities Corporation was incorporated last week in Albany with a capital of $3,000,000. The principal office is in Schenectady, and the purpose of the corporation is to manufacture and deal in electrical, gas, water and steam power machinery. The stock is divided into $1,000,000 preferred and $2,000,000 common. The directors are nearly all officers of the General Electric Company.

The Edison Electric Illuminating Company of Brooklyn has annouced a general reduction of 20 per cent. in the price of electric light service, to go into offect on January 1 next. According to the officers of the company, the reduction is not forced by competition, but is due to the reduction in the cost of manufacture and of the transmission of electric power.

The Allis-Chalmers-Bullock combination won the highest awards at the St. Louis Exposition, the grand prizes for steam, electrical and mining machinery, the gold medal for the Bullock system of operating variable speed electric motors for driving machinery and also for the Allis-Chalmers big reliable engine, the largest ever seen on exhibition, and for the Bullock electric generator. The Allis-Chalmers exhibit in the department of mines and metallurgy was also awarded a prize.

Mr. Homer E. Niesz of the Chicago Edison Company has accepted the position of editor of Question Box for the 27th convention of the National Electric Light Association and has already begun work on same. Mr. Niesz proposes to get into communication with every central station in the country, if possible, and to reach every member of the companies interested in presenting either questions or answers. By beginning the work so early as this, Mr. Niesz will be able to sift both questions and answers thoroughly and to make a selection of such as will be of greatest interest to the greatest number of managers.

The New York Central's electric locomotives for express trains are of 2,200 hp., or 700 hp. stronger than the giant steam engine that draws the Empire State Express. They are to have a speed, drawing a heavy train, of 75 to 80 miles in hour. They have more than twice the drawing strength and four times the speed capacity of the locomotives that handle the Baltimore & Ohio's 100-train daily traffic in the city of Baltimore. Upon the successful operation of these colossal locomotives will depend to some extent the rapidity with which electricity advances in its contest with steam for the supremacy of the railroad traffic in this country.

In accordance with a resolution of the Franklin Institute, the Philadelphia Board of City Trusts awarded the John Scott medal and premium to the following inventors: Evan W. Jones, of Portland, Ore., for his underfeed stoker; J. Allen Heany, of York, Pa., for an inclosed arc lamp; Amos E. Burrows, of York, Pa., for a feed-water regulator; Dr. Schuyler S. Wheeler, of Ampere, N. J., for his electric buzz fan; J. W. Lattig, of Wyncote, for an automatic electric semaphore signal, and James M. Dodge, of Philadelphia, for a new cold storage structure.

Secretary Farrand requests us to state that the proceedings of the 27th convention of the National Electric Light Association, recently held at Boston, are now nearly ready for distribution. As the proceedings cover about 1,300 pages, the book will be issued in two volumes. It has also been found necessary to use smaller type, owing to the bulk of matter to be printed. These volumes are not only the most important in respect to size ever issued by the Association, but the character of the papers, reports and discussions—and especially of the Question Box and Wrinkles—is proportionately valuable. As the book will be furnished only to members of the Association, it will be worth the while of any central station not already a member to make application at once.

PROCEEDINGS OF THE AMERICAN STREET RAILWAY ASSOCIATION CONVENTION AT ST. LOUIS.

The street railway associations sent large delegations to St. Louis last week to attend the annual convention. The first session was opened by the American Mechanical and Electrical Association.

President E. W. Olds of Milwaukee called the meeting to order at 11 o'clock. President Ely, of the American Street Railway Association, and President Smith, of the Accountants' Association, were invited to take seats upon the platform.

President Olds—We have present with us this morning one who started in the ranks down low with us, who is a practical man and knows what it is to work hard. I refer to Mr. John I. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, who will now make an address to us.

Mr. Beggs made a lengthy address, in which among other things he stated that the master mechanics, the superintendents of way, the accountants and the claim men should all be in one organization in conjunction with the association of managers.

President Olds then presented Mr. Beggs with one of the badges of the Mechanical Engineers' Association, which Mr. Beggs accepted with thanks.

President Olds—We also have with us to-day another of our practical street railway men, one who holds the highest office in the gift of the American Street Railway Association. I refer to Mr. W. Caryl Ely, of Buffalo, who will now address you.

Mr. Ely then made some remarks and among other things said: "For some years past it has been evident to all that a change was coming in the affairs and management and the scope of the work and operations of the American Street Railway Association. Eight years ago the first secession, if you please, was brought about by the accountants, who organized an association which has done excellent work. A year ago at Saratoga the first meeting of this Mechanical and Electrical Association, as an organization, was held, and that was the result of several years' agitation. Now the superintendents of way, or the engineers of way, or the superintendents of way and construction, as they are variously entitled, are knocking upon your doors for admission, after having for a time contemplated the formation of a separate organization for themselves. Now the question arises where will it all end, and it seems to me that the parent association is in much the same situation that the mistress was who had a cook for a good many years, and was informed that the cook was about to leave her. She said, 'Why, Bridget, what is the matter, that you are going to leave me after all these years? Have I not treated you like one of the family?' 'Indeed you have,' was the reply, 'but I have stood it as long as I can.' Now it seems to me that there is something wrong in our family and it ought to be fixed up in such a way that you could stand it a little longer; and I suppose that it must take the form of an organization of some kind, but interdependent in some way and connected with the other associations and the parent organization."

Mr. F. E. Smith, president of the Street Railway Accountants' Association of America, was called upon and very briefly expressed his pleasure at being present at the meeting of the Mechanical and Electrical Association.

President Olds then read his address which was in part as follows:

"When this association was first organized, it was thought best to confine the membership entirely to mechanical and electrical men. I think this is a mistake. It is of equal importance to those having the way and transportation departments in their charge that they be well informed regarding the equipment and its care and maintenance. We find that other departments need to be represented and are knocking at the door for admission to our association; we must realize that our interests are nearly identical with those of other departments.

"The object of this association is to treat of mechanical and electrical subjects and exchange views and ideas upon the best methods of maintenance and operation. To do so intelligently we must be well informed regarding the work required of our cars and motors.

"There is also an agitation upon the part of some of the other departments for reorganization of the parent association, to be so arranged that each department will have its own sub-organization, under the control and direction of the parent body.

"Before closing, I wish to thank you for the high honor you have conferred upon me, and I shall ever consider my term of office as president of your association as one of the brightest spots in my career as a street railway man.

"I bespeak for my successor the same generous support that you have given me. Let us ever be aggressive, fair-minded and ready to fight for what is just."

The meeting then adjourned.

AFTERNOON SESSION.

President Olds called the meeting to order at 2:30 o'clock, and said the next item of business on the programme was the report of the executive committee.

Secretary S. W. Mower made the report and stated that during the past year the following new members had been acquired by the association: Seven companies, 36 active members, and 4 junior members, making a total of 47 new members during the year. The total membership at the present time is 150.

On motion of Mr. Baker the report of the executive committee was accepted as read.

The president announced that new business would be taken up, and under this head the amendments to the constitution and by-laws, to provide for the admission of superintendents of the way department in the organization, were considered.

Mr. C. F. Baker, of Boston, moved that the chair appoint a committee of three, selecting one of the way-men, to attend the meeting of the executive committee of the American Street Railway Association.

This motion was agreed to.

Mr. W. O. Mundy suggested that as some of the present officers of the Mechanical Association had become independent consulting engineers, or engaged in pursuits other than that of engineers for members' companies of the association, that the precedent should be established that no member of the association, who was not in the employ of a member company, should hold office after the expiration of his term.

President Olds called attention to the fact that at the last meeting of the association, held at Saratoga Springs, the matter under discussion was fully covered.

On motion of Mr. Alfred Green, it was voted to have the name of the association remain as it is until the meeting next year.

The president announced the next order of business would be the reading of papers.

Mr. W. D. Wright, superintendent of equipment of the Rhode Island Company, Providence, R. I., then read his paper on "The Ideal Shop." The paper was very fully discussed by Messrs. Mundy, Lake, Wright, Adams, Pestell and others.

President Olds then announced that the next business was the reading of the paper by Mr. J. Millar, superintendent of rolling stock, International Railway Company, Buffalo, N. Y., on "Wheel Matters." Mr. Millar read the paper.

Owing to the lateness of the hour the discussion of the question box was deferred until the meeting on Tuesday, and the meeting then adjourned.

TUESDAY MORNING SESSION.

President Olds called the meeting to order at 10:45 o'clock, and announced that he had appointed as the committee to confer with the executive committee of the American Street Railway Association on the subject of a reorganization of the associations, the following named gentlemen: C. F. Baker, H. H. Adams and F. G. Simmons.

The convention then proceeded to the consideration of the paper on "Maintenance and Inspection of Electrical Equipment," by John Lindall, general foreman of shops, Elevated Division, Boston Elevated Railway, Boston, Mass. As Mr. Lindall was not present at the meeting, the paper was read by Mr. Alfred Green.

President Olds appointed the following named gentlemen as a committee on nominations: W. O. Mundy, Alfred Green, J. Millar, W. D. Wright and W. K. Evans.

The meeting then adjourned until 2:30 o'clock.

TUESDAY AFTERNOON SESSION.

President Olds called the meeting to order at 2:30 o'clock and stated that the first business of the session would be the consideration of the Question Box. The secretary read the printed questions and answers, and there was a very spirited and valuable supplementary discussion by the members generally of the questions contained in the Question Box.

Mr. Mundy, chairman of the committee on nominations, reported the following gentlemen for the officers of the association for the ensuing year:

President—C. F. Baker, Boston.

First Vice-President—H. H. Adams, Baltimore.

Second Vice-President—John Millar, Buffalo.

Third Vice-President—F. G. Simmons, Milwaukee.

Secretary and Treasurer—S. W. Mower, Detroit.

Executive Committee—D. F. Carver, Jersey City; J. S. Doyle, New York; C. C. Lewis, Schenectady, and W. H. McAloney, Denver.

On motion the secretary was authorized to cast the ballot of the association for the officers nominated.

American Street Railway Association.

The 23d annual convention of the American Street Railway Association was held in the Transportation Building, Louisiana Purchase Exposition, Wednesday and Thursday, October 12 and 13.

WEDNESDAY'S SESSION.

President W. Caryl Ely, of Buffalo, called the meeting to order at 10:15 o'clock, and said: "We will proceed directly to business, as we have with us the president of the Louisiana Purchase Exposition, who has taken of his valuable time enough to come here and say something to us, and we will not detain him by proceeding at the present time with any roll call or any regular order of business, and I will therefore introduce him to you at once. I take pleasure in introducing to you the Hon. David R. Francis, President of the Louisiana Purchase Exposition. (Applause.)

Mr. Francis in his speech traced the history of the Exposition and referred at considerable length to the means of transportation and how successfully they had proven both financially and electrically.

President Ely—We must not detain the Governor any longer. I merely wish to express our thanks to him for having come here and welcomed us, and also for the great amount of information he has given us concerning this Exposition and its buildings, and what it represents.

We expected that the mayor of the City of St. Louis, the Hon. Rolla Wells, would be present this morning to make an address. He has not arrived, and I have now the pleasure of calling upon Prof. W. E. Goldsborough, chief of the department of electricity of this Exposition, who has kindly consented to talk to us concerning the matters of interest to us in the Exposition.

Prof. Goldsborough briefly described the principal electrical and mechanical features of the Exposition, especially those relating to transportation.

President Ely—I am sure the remarks of Prof. Goldsborough have been intensely interesting, and in your behalf, gentlemen, I extend him the thanks of the association for his courtesy, not only in this regard, but for his uniform courtesy and devotion to this convention since the first time it was brought to his attention.

The Hon. Rolla Wells, mayor of St. Louis, then made a short address and extended to the members the courtesy of the city.

President Ely then delivered his address and reviewed the entire field of electric railroading for the past year. He referred to the suggestions of a reorganization of the parent body, and requested that the members bury all questions of prerogative, precedence and personal advantage and unite in a vigorous and persistent effort to bring out of present conditions an organization satisfactory to all.

President Ely—The next order of business is the report of the executive committee on the management of the association during the past year.

The secretary read the report of the executive committee which consisted of the minutes of the various meetings of the executive committee held on February 29, March 26, September 10 and October 11, 1904, at which meetings the various arrangements were made for the St. Louis convention.

The president then announced as the censorship committee, the following named gentlemen: J. C. Hutchins, C. O. Mailloux and John I. Beggs.

The president appointed the following named gentlemen as the nominating committee to nominate officers for the ensuing year: J. C. Hutchins, of Detroit; C. S. Sergeant, of Boston; Robert McCulloch, of St. Louis; H. M. Littell, of Chattanooga, and John I. Beggs, of Milwaukee.

THURSDAY'S SESSION.

After calling the convention to order the president asked for the report of the secretary and treasurer. The present membership is 196; balance on hand, $7,646.56.

The paper on "Steam Turbines" was read by R. H. Rice.

The paper on "Steam Turbine Power Plants," was read by J. R. Bibbins.

The paper by E. D. Meier, on "The American Diesel Engine," was read.

These papers were discussed by the members at some length.

Officers were elected for the ensuing year as follows:

President—W. Caryl Ely, Buffalo, N.Y.

First Vice-President—Elwin C. Foster, New Orleans, La.

Second Vice-President—John I. Beggs, Milwaukee, Wis.

Third Vice-President—Richard McCulloch, St. Louis, Mo.

Secretary and Treasurer—T. C. Penington, Chicago, Ill.

Executive Committee—The officers and John J. Stanley, Cleveland, O.; Howard F. Grand, Seattle, Wash.; C. G. Goodrich, Minneapolis, Minn.; F. G. Jones, Memphis, Tenn.; W. E. Harrington, Camden, N. J.

The selection of the next place of meeting was left to the executive committee. The convention adjourned sine die at 2 P.M.

THE PRUSSIAN SYSTEM OF ELECTRIC TRAIN LIGHTING.*

BY HERR CARL RODERBOURG.

The Prussian State Railways, including the Hessian Railways, are operated under a common financial administration, and have a length of 31,276 kilometers. Their rolling stock comprises 13,196 locomotives, 24,307 passenger cars and 294,636 freight and baggage cars. The lighting of the locomotives and passenger cars has heretofore been exclusively by oil gas (Pintsch system), to which recently 33⅓ per cent. of acetylene has been added to increase its illuminating power.

Experiments with the electric lighting of the Prussian Government Railways have been proceeding for some time, but on a very small scale, while various private railroads in Prussia had equipped their trains with electric lighting. The Prussian Ministry of Railways assumed a waiting attitude and limited itself to the study of the experiments made by other railroads and particularly those in America.

On November 8, 1900, there occurred an event which brought forward the question of electric train lighting in its application to the Prussian State Railways. In a train collision at Offenbach, near Frankfort-on-the-Main, a number of cars were set on fire, and the conflagration spread with such rapidity that many lives were lost. The public and the press attributed the main cause of the rapid spread of the fire to the escape of gas from the tanks under the cars, a fact which was, however, contradicted by the railroad administration. The matter was also officially discussed in the Prussian House of Representatives, and while it did not appear that the danger from the gas tanks had been clearly proven, it was decided by the administration of the Prussian State Railways as a result of this accident to proceed energetically with experiments in the introduction of electric train lighting.

Privy Councilor Herr Wittfeld in the Prussian Ministry of Railroads laid down the following fundamental principle to be followed in the experiment: "No automatic switches or regulating apparatus shall be used in electric train lighting." Although the Prussian State Railway administration made no objection in exceptional cases to the conduct of tests with lighting systems which did not comply with this general principle, it was generally adhered to.

Next to Herr Wittfeld, credit is due Herr Dr. Buttner of the Accumulatoren-Fabrik Aktiengesellschaft that it was made possible to light railroad trains and single cars by electricity without the use of automatic regulators and switch apparatus and without handling an excessive weight of storage batteries. With this system electric current for the incandescent lamps is produced by the well-known method of having one or more dynamos on the train itself. Connected in parallel with them are storage batteries hung under the cars, which in case of need supply current for the lamps, and which may be recharged by the dynamos.

Following a suggestion of Herr Wittfeld, Herr Dr. Buttner has succeeded by the use of special apparatus in avoiding variations in illuminations noticeable to travelers, notwithstanding the difference in EMF. of the storage batteries during charge and discharge, and securing constancy of pressure at the lamp terminals without special regulation notwithstanding the variable speed of the dynamos.

Although there is a loss of energy inherent in the system, it offers the advantage of complete reliability in operation and simplicity in handling; and the Prussian Railway administration is of the opinion that more importance should be attached to this reliability in operation than to the increased energy consumption which is small relatively to the whole train. The principle of the constant EMF. at the lamps with variable EMF. of the source of energy is attained by the insertion of very small iron wire in the circuit of each incandescent lamp. The wire is in small glass pear-shaped globes like incandescent lamps, containing hydrogen gas. By varying the pressure of these gases as well as by the adoption of a special spiral form of wire, the temperature of the wire when current is passing is brought to the proper point. If an iron wire is heated by electric current to a point at which it becomes barely visible in the dark, its electrical resistance increases with extraordinary rapidity with further increase of temperature. If the EMF. increases, the temperature of the wire increases instantly and consequently its resistance, so that within considerably wide limits of EMF. little more current is allowed to pass than in the case of low EMF.

If such a wire is connected in series with an incandescent lamp the EMF. at the terminals can be considerably increased without subjecting the lamps to an excessive current. Such an iron wire resistance had been previously in use by the Allgemeine Elektricitats Gesellschaft to steady the Nernst lamps in the ordinary lighting circuits. To Herr Dr. Buttner belongs the merit of having applied the method to incandescent lamps and for much greater variations in pressure.

The variations in current which result from the insertion of iron wire in series with incandescent lamps is shown in the following table for various EMFS.:

VARIATION OF CURRENT WITH EMF.

Line EMF.		Current.	
56	Volts.	8.0	Amperes.
58	"	8.1	"
60	"	8.2	"
61.6	"	8.3	"
63.6	"	8.4	"
65	"	8.4	"
70	"	8.41	"
72.5	"	8.43	"
76	"	8.46	"
82	"	8.5	"
83.5	"	8.55	"
84.9	"	8.6	"
86	"	8.7	"

Owing to the fact that the variation of pressure due to the use of storage batteries in train lighting is very much less than indicated in the table, and moreover takes place slowly, the variations in the illumination of the cars are not perceptible to the eye under such conditions.

Two through trains connecting Berlin and Hamburg on the Prussian Railway system, and subsequently two additional trains on the same line, and finally two trains between Berlin and Stettin, were similarly equipped. The trains are always operated as a unit, and each train is equipped with only one shunt dynamo which is mounted on the boiler of the locomotive and driven by a 20 hp. De Laval steam turbine.

The dynamo is coupled to the reduction shaft of the turbine, the turbine disk making 20,000 revolutions per minute, while the dynamo runs at 2,000 revolutions. The dynamo develops 180 amperes at 68 volts, but can develop continuously a greater output and at a higher EMF. in order to charge the storage batteries. The storage batteries of the Accumulatoren Fabrik A. G., Berlin, are connected in parallel with this dynamo; a battery of 32 cells with a capacity of 76 ampere-hours at a three-hour discharge rate is hung under each car. The storage batteries act mainly as a reserve; they become operative only when the locomotive becomes separated from the train or the dynamo should fail for any cause.

The maintenance of the whole equipment is very simple. The engine-driver starts his turbine at a certain hour, connects the circuits and gives no further attention except in case he desires to charge the storage battery, when he cuts out the

*Paper presented before Section E, Electric Light and Distribution, at the International Electrical Congress, held at St. Louis, Mo., September 12-17, 1904.

resistance in the field circuit of the dynamo. The switching on of the lamps is done generally by the porters, partly also by the passengers. This arrangement has operated satisfactorily from the start. In the meantime the Prussian Railroad administration has gone a step further and for the following reasons:

The system under consideration if adopted on all through trains would necessitate the equipment of all the locomotives of freight trains. The number of these locomotives is much greater than the number of trains owing to the fact that the locomotives are often changed on long hauls. On the contrary the baggage wagon at least accompanies the train on the whole run. It appeared desirable on this account not to install the dynamo on the locomotive but in the baggage car, and in this way the number of dynamos required could be materially reduced. To drive the dynamo by any form of engine power, a benzine engine for instance, appeared too complicated. The most convenient form of drive is no doubt that from the car axle. This requires that the dynamo be operated at not even approximately constant speed.

Furthermore, there are a number of through cars, which in transit are transferred from one express train to another, in order to avoid change of cars to the passengers between main points having no direct express connections. These through cars often run beyond the jurisdiction of the Prussia State Railways, into Saxony, Bavaria, Switzerland, Italy, etc. If it is desired to furnish these with electric lighting, it can be done only if they are equipped each with its own dynamo, which must be adapted to the various lighting systems in use on the different express trains to which they may be coupled. In this case the only possible method of driving the dynamos is from the car axle.

All similar systems hitherto used are equipped with a circuit-breaker which interrupts the current if the speed of the dynamo falls below a certain limit, in order that the storage battery, whose EMF. is greater than that of the dynamo at low speeds, may not discharge into the dynamo. This circuit-breaker is automatic, and is liable to derangement on account of shock, and it does not therefore conform to the Wittfeld principle, above cited. Herr Dr. Buttner, therefore, substituted for it a so-called unipolar or electrolytic rectifying cell. The electrodes of such a cell consist on one side of aluminum, and on the other of any metal not soluble in the electrolyte of the cell. It is well known that aluminum has the remarkable property of cutting off a current even of several hundred volts if sent through the aluminum into the electrolyte in a positive direction, but allows the current to pass almost without diminution if the direction is reversed. The selection of the electrolyte is important, most of them in the course of time attacking the aluminum and destroying the electrode. Others have the peculiarity that the effect of the aluminum plate ceases when the temperature exceeds 40 to 50 degs. C. Herr Dr. Buttner has succeeded, after experimenting with many different solutions, in finding a mixture which does not attack the aluminum plate, nor diminish its efficiency even should the temperature rise above 70 to 80 degs. C.

As a second electrode he uses iron plates in his cells, and these aluminum cells, which act as a check valve in his train lighting system, are inserted in place of the automatic-breakers. While the EMF. of the dynamo preponderates, it sends current through the aluminum cell into the line. The drop in the aluminum cell may then reach as high as three volts. If the speed of the dynamo diminishes and its EMF. falls below the terminal voltage of the battery, the aluminum cell cuts off the current and the dynamo may come to rest or even have its rotation reversed without permitting current from the battery being sent into the dynamo and wasted.

An arrangement is in addition applied to the dynamo to provide for the case of a car going in the opposite direction, the commutator brushes being carried forward until a point is reached at which the dynamo generates current in the same direction as before. This arrangement can be avoided if, in accordance with the suggestion made to Herr Dr. Buttner by Herr Liebnow, four aluminum cells are used instead of one in the conversion of alternating into direct current. In this case, however, the drop may reach six volts. Another arrangement is in preparation by which this also is avoided. The dynamo, which in general is designed as a shunt machine, is supplied with the supplementary main circuit working on the fields which lowers the EMF. if the current becomes excessive. In this way the excessive charging of the storage battery at very high speeds is prevented; otherwise the arrangement is as above described. At the present time two trains are being operated between Berlin and Cologne on which the dynamo is installed in the baggage wagon, driven from the axles by belts. Several through cars are now in construction in which the armature of the dynamo is mounted directly on the car axle.

The following instructions are given for the maintenance of the equipment:

1. The ball bearings should be inspected every two weeks at first, and then every four weeks, to insure that there is a sufficient supply of vaseline. The ball bearings should be cleaned and supplied with fresh vaseline every six months.

2. The pole-charger on the armature shaft must allow of easy motion in both directions by turning the armature.

3. The commutator should be kept round and smooth.

4. The carbon brushes should be held firmly by the brush-holders and impinge on the commutator with a gentle pressure.

5. The belt should be tested particularly at the joint to confirm its satisfactory operating condition.

6. The wood driving pulley should be inspected as regards tightness on the shaft.

7. The screw shaft of the belt tightner should be properly oiled and after tightening of the belt should be secured.

8. The dynamo bearings must not heat so as to be uncomfortable to the touch. If a bearing heats, the belt should be slackened until the dynamo no longer rotates. The storage batteries should be handled in accordance with the specific instructions. The specific gravity of the solution should be measured every eight days in order to ascertain if the batteries have received sufficient charge while en route. If the specifie gravity of the solution is too low, the EMF. of the dynamo should be increased. If the car follows a new route, it is recommended that a measurement be made at the end of each trip.

The following observation should be made on the aluminum cell: Before filling the cell with electrolyte, the plates and the tank should be carefully cleaned. To accomplished this the aluminum plates should be placed in dilute sulphuric acid for six hours and the acid washed off by several applications of water. The plates should then be washed off with distilled water and inserted in the tanks.

The electrolyte should not be allowed below the upper edge of the plates. It should stand 2 to 3 cm. above the upper edge of plates. If the cells are allowed to stand unused for a long time, in switching into the circuit a heavy current will pass in the first moments at the point of cut off, but it will return to zero in a short time. This passage of current may determine the fusing of the safety catches

of the circuit, and the cell should therefore not be cut into circuit at once, but should first be conected to the battery through a resistance such as an incandescent lamp or a part of the field resistance of the dynamo. The electrolyte must be renewed from time to time, which can be done when the cars are sent to the shops for overhauling. At this time the plates can be freshly cleaned with sulphuric acid as above described.

As the illumination of the cars is very abundant, and as special reading lamps, which can be switched on or off by the passenger, are attached to the backs of the division between every two seats, the electric lighting of the trains is very popular with the public, and in a number of instances letters have been sent to the Royal Prussian Ministry of Railways expressing appreciation of the improvement. The administration is much pleased with the experiments and is proceeding steadily with the equipment of additional trains and single cars. It is therefore probable that the Prussian Railways Department will gradually equip all of its trains with the electric light, and that electricity will in the near future achieve in this field also a victory over all other methods of illumination.

MOTOR DRIVEN PUMPS.

ARTICLE II.

BY W. H. WAKEMAN.

Fig. 4 is a side view of a horizontal triplex power pump, designed for heavy pressures. It is driven by an electric motor, and as such pumps are frequently located several hundred yards distant from the boiler room this mode of transmitting power is superior to all others. The plungers are outside packed, thus securing all advantages gained by this type. Any leakage is at once detected, whereas in the piston type it might not be discovered for months.

Shocks and jars are still further guarded agains by means of an alleviator over each water cylinder, one of which is shown in the figure. As already mentioned in connection with other pumps, either two or three pistons give a continuous flow of water with all its advantages, but still this flow is not always uniform. The large gear on the crank shaft revolves at a uniform speed for stated conditions, but this does not result in a uniform speed of crosshead and plunger, as the angularity of connecting rod gives an unequal motion here, the same as on a horizontal engine, consequently more water is delivered at some parts of the stroke than at others.

For ordinary pressures this is unworthy of notice, but as pressure is increased, these little points demand more attention where smooth service is required, therefore these alleviators are used with good effect, as they modify the unequal delivery, affording an improvement in this respect.

Where a direct current induction motor is used, it may be started without using a clutch, as the rheostat admits of bringing it slowly up to full speed. In such a case however, it is customary to provide a by-pass containing a gate valve, thus allowing water to circulate under little or no pressure until full speed is attained, when the gate valve is slowly closed, thus putting on the load without shock or jar.

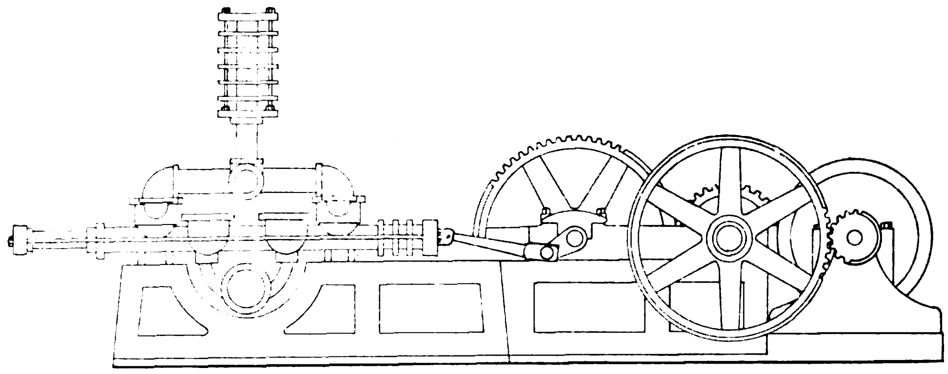


FIG. 4.

Fig. 5 represents another form of horizontal pump driven by an electric motor. This is a single acting pump, the water valves of which are actuated by a mechanical device as shown. This gives positive action of valves regardless of the amount of water flowing through them. It also admits of a higher lift of valve than is otherwise practical.

Motors may be divided into two classes, one of which requires the motor to run at full speed before the load is thrown on while the other will start at full load, although the same power is not developed at first, owing to the slow speed.

These pumps are adapted to service where water must be forced upward for 500 feet or more. This action is sometimes called lifting it 500 feet, but this appears to be a mistake, as it is impractical to lift water more than 30 feet. It is doubtless only a form of expression in either case, but where water is raised to a pump it is proper to refer to it as lifting, but where said water goes above the pump it should be called forcing it, in order that a distinction may be made between the two operations.

Fig. 6 illustrates a vertical triplex single acting air pump for use with a

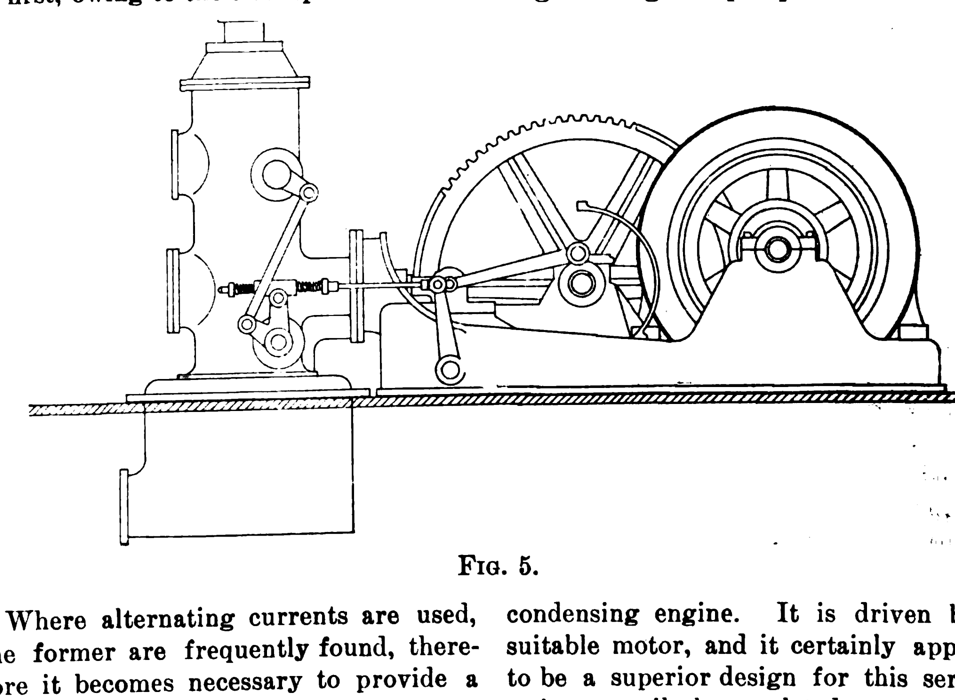


FIG. 5.

Where alternating currents are used, the former are frequently found, therefore it becomes necessary to provide a clutch by means of which the motor may be disconnected until it attains full speed, when the clutch can be thrown in gradually, the motor taking its load accordingly.

condensing engine. It is driven by a suitable motor, and it certainly appears to be a superior design for this service as it can easily be regulated to meet varying conditions. In large plants an independent engine is used to generate current for lighting the engine and boiler rooms when the main engine is shut

down, also to supply small motors for use on repair work, etc. This enables the engineer to start his air pump before starting his main engine, thus clearing the cylinders, receiver and pipes of water resulting from condensation of steam.

This independent engine should be run non-condensing as a rule, and its exhaust steam forced through a feed water heater, in order to raise the temperature of feed water as it comes from the hot well, resulting in economy of fuel and preventing injury to boilers by uneven contraction.

These pumps may be used in connection with surface condensers, or applied to jet condenser service, although each requires a peculiar design in order to give satisfaction. They may be made double acting if desired. A vacuum breaker is supplied for use in connection with them, thus preventing accident to the engine by water collecting in the exhaust pipe.

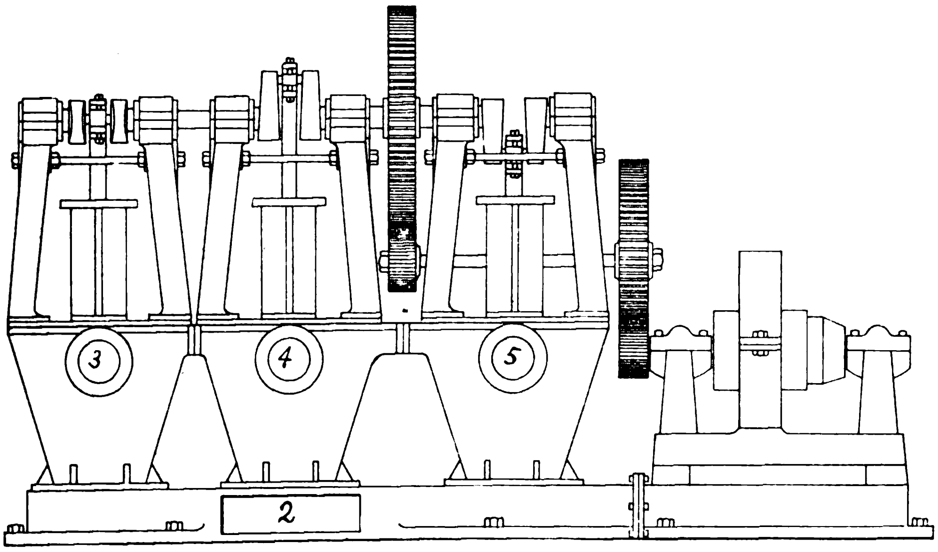


FIG. 6.

The speed of an electric air pump may be increased at pleasure to maintain the desired degree of vacuum, provided one or more leaks appear in the pipe or its connections, and there is not time enough at our disposal to remedy the evil.

The action of an air pump and the reason for its being so called seem to require brief explanation at this point.

A non-condensing engine exhausts its steam into the air against about 15 pounds pressure, where the air is dense enough to make this pressure, and this back pressure acts on every square inch on the face of piston. The steam is sometimes exhausted into a closed vessel called a surface condenser, that is filled with tubes. The exhaust steam surrounds these tubes, while cold water is circulated through them by a circulating pump. After leaving the surface condenser the exhaust pipe is connected to the air pump at 2, Fig. 6, which pumps out everything coming from the condenser. This includes water resulting from the condensation of steam, and all air that was formerly in the steam, which was liberated as the pressure lowered and condensation resulted, hence the name "air pump." All this is discharged through the pipes 3, 4 and 5.

If a jet condenser is installed, but one pump is used, and that not only draws steam and air out of the steam cylinder, but also draws the water for condensing purposes in through another pipe, then discharges the whole into a hot well from which the boiler feed water is taken at from 110 degs. to 120 degs. Fah. Of course the capacity of a jet condenser pump must be greater than a surface condenser air pump for the same engine.

A condenser reduces the load on an engine by dispensing with a large percentage of the back pressure, hence it requires less coal to generate steam for operating a given amount of machinery as a natural consequence.

SIMULTANEOUS TELEGRAPHY AND TELEPHONY.*

BY JOSEPH HOLLOS.

The question of simultaneous telegraphy and telephony is not of recent date. While, however, in some places, good results have been obtained, in others the advantages reached by this combined using of telephonic circuits are hardly worth mentioning, and in view of the difficulties experienced in the service, it was thought preferable to abandon the scheme.

If we look closer at the question, we can at once observe that wherever the telegraph and telephone services are under the supervision of one and the same interested person, the results obtained are excellent. Where, however, the two systems are in different hands the result is unsatisfactory. Thus, in America, where the financial interest of the telephone companies is involved, because of the desire to increase income by leasing lines for simultaneous telegraphy, and where, for this reason, these two operations are under the control of one technical staff, the result is excellent. The results are also fair in the European services, if the same technical officer supervises both telegraphy and telephony, and one service is co-ordinated with the other. The result is, on the contrary, very poor in all cases if the telegraph and the telephone services are in different hands.

This is evident if we consider how greatly the one system interferes with the other; that is, that careless handling of the one interferes at once with the proper functioning of the other, the two systems thus being brought into mutual opposition.

For this reason the service must be arranged in such a manner that the two systems cannot interfere with each other, and in as far as troubles are unavoidable, they must be reduced to a minimum. If they should exceed, certain arrangements must be provided to hold out the less important service without delay.

In this direction the Hungarian telegraph and telephone service can show good results by comparison with similar installations, and, therefore, it will not be without interest to outline the principles which were followed in the formation of the system.

Above all, the simultaneous installation must be the simplest possible, because only thus and with the fewest possible instruments may undisturbed working be obtained. For this reason the method of simultaneous working, founded on the Wheatstone bridge principle, was made the basis of procedure.

The telephone circuit is closed through two inductive branches. At their point of intersection the battery branch is led off to the group of telegraph apparatus, while the telephone apparatus is placed in the so-called galvanometer branch.

It is thus evident that the connecting-in of the telephone apparatus—namely, the leading of the telephone circuit through the switchboard—requires some care, because if there is a ground in the switchboard connections the telegraph working is disturbed. Even if one telephone circuit is directly connected to another, and there be simultaneous working on the lat-

*Paper presented before Section G, Electric Communication, at the International Electrical Congress held at St. Louis, Mo., September 12-17, 1904.

ter, the two telegraph simultaneous systems are brought into contact, which again causes marked disturbance. This may also be caused by the operators ringing simultaneously on several circuits from the same common source of ringing current.

Even if only one of the circuits fed from the common ringing source is connected for simultaneous telegraphy, such working will still be slow, because, in ringing on the simultaneous conductor, we ring also on five or six other conductors. However well insulated these circuits may be individually the insulation of the simultaneous telegraph circuit will be so far reduced by the connection that it will hardly be possible to maintain continuous telegraph working.

It is true that we can remove all these difficulties at one stroke, by connecting the incoming telephone circuit, before leading it to the switchboard, to a repeating coil and working then only on the other half of the repeating coil. But by this plan the difficulty is only transferred to the other side—the telephone side. Above all, we have a loss of energy in the repeating coil to which are added losses inevitably occurring in the signaling apparatus, and it may happen that with such an arrangement the telephone subscriber does not get as much as 50 per cent. of the incoming speaking energy into his receiver. We must strive, therefore, that along with the undisturbed working of the telegraph, the telephone working be kept at the same relative level that would exist in the absence of simultaneous working. Moreover, the repeating coil not only weakens the speaking current but also the calling current, and we must, therefore, take precautions in this direction.

Under these conditions it is inadvisable to connect the circuit first to the repeating coil. As long as the circuit is on the calling apparatus there is no danger of disturbing the simultaneous working. The disturbance arises only at the moment of connecting. For this reason it would be sufficient to place the repeating coil in the connecting cord; but in the same path there is also the clearing-out signal, and a great loss of energy might thus be incurred. This we may, however, remedy if the repeating coil is constructed in such a manner as to serve at the same time as the clearing-out signal.

The clearing-out signal is, as a rule, connected in the bridge between the two branches of the circuit, and its duty is by its great self-induction to prevent the wasting of any considerable part of the speaking current. How far it is able to satisfy this demand might be readily ascertained by inserting a receiver in the shunt path. In spite of thus increasing the impedance of the bridge, we still obtain intelligible speaking even with a clearing-out signal of 2,000 ohms resistance, if the latter is entirely embedded in iron. These currents do not so rigidly follow the rules which apply to strong currents and, therefore, inferences drawn from such rules do not apply in this case, as may be shown by a simple experiment. With such a clearing-out indicator 30 per cent. of the energy is lost on the average, and 70 per cent. only is available, as I have been able to ascertain myself.

With a well-constructed repeating coil, if arranged as a clearing-out signal, the loss is not greater. Consequently if we insert such a repeating coil into the connecting cord simultaneous working without affecting the telephone is secured.

The repeating coil transformed into a clearing-out drop naturally possesses a closed iron circuit. In European practice this plan is avoided and an open-circuit repeating coil is generally preferred. The question whether the repeating coil has an open or closed magnetic circuit does not affect the high frequency involved, and for weak currents this is of much less importance than the other losses that arise in an open-circuit repeating coil.

For relatively strong signaling currents the closed iron circuit is of decided advantage, because with open-circuit repeating coils it is only exceptionally possible to ring through with alternating current, while it is always certain when there is a closed iron circuit.

From the point of view of simultaneous working it only remains to separate the ringing currents.

This may be accomplished if alternators are used by branching the ringing current at each operator's position on a separate repeating coil. Where batteries are used, which are to-day exceptional, each operator's position must be given its separate battery. This is a matter for the technical department.

As for the operating department it is only desirable that the telephone and telegraph operators should be able to communicate with each other quickly, so that they can co-operate in case of troubles.

In the simultaneous working apparatus itself, the branching coil is of the highest importance. It is most important that the inductance on the two sides should be equal. This is more important than the exact equality of their ohmic resistance. This, however, determines not only the resistance of the coil but also the size of the copper wire to be used.

From this point of view of choking, it is desirable to use long coils; such coils, however, by reason of the phenomena of dispersion, prevent the complete neutralization of the telegraph currents, and, therefore, it is necessary to select short coils. With such an arrangement the operation of the telegraph apparatus is not perceptible on well-balanced telephone circuits.

In the Hungarian Telephone System the results hitherto obtained with simultaneous telegraphy and telephony, in the manner above described, have been excellent.

CARS—THEIR EQUIPMENT AND MAINTENANCE.*

BY JOHN ALDWORTH,
General Manager Nottingham Corporation Tramways.

(Concluded from page 206.)

The writer has tried several kinds of white metal for lining motor and armature bearings, also solid gunmetal armature bushes of different mixtures; the latter, however, are not being renewed, but when worn down are bored out and run up with white metal instead of being scrapped. This has been found to answer well, besides affecting the following saving in the cost of renewals under this head: Gunmetal bushes for one armature, including boring and turning, after allowing for their scrap value, 18s. 1½d. Boring out old bushes, filling with white metal and boring, 5s. 8d. Each subsequent relining and boring, 1s. 8d., or a difference of 16s. 5½d. in favor of white metal lining. The average life of the gunmetal bushes has been 25,086 miles, and that of the line bushes practically the same. A further advantage is found in the fact that should a bearing run hot, there is not the same danger of the shaft being scored with white metal as in the case with gunmetal. A metal is now being tried for lining, composed of three parts of virgin spelter to one part block tin, which is considerably harder than any other white metal tried. This has not been in use sufficiently long to enable particulars to be given of the mileage to be obtained from bearings so lined; but so far they have given good results, the journals being in excellent condition, and the writer has no hesitation in saying that they will give a considerably increased mileage.

Armatures, field coils and leads are thoroughly examined, tested and coated with insulating compound, also commutators turned up, if required, every time

*Paper read before the Municipal Tramways Association of Great Britain, September 28, 1904.

the car passes through the repair shops for overhauling the bearings. The writer believes that considerable advantage would result from having commutators ground true instead of being turned up in the lathe, and is now experimenting in this direction. The condition of the armature bearings of each car is determined at least once a month by the night foreman, who tests the clearance between the armature and bottom fields, for which purpose he is provided with a set of steel feelers, numbered and varying in thickness from $\frac{3}{16}$ inch to $\frac{1}{32}$ inch. The exact clearance of each armature is recorded and sent to the works superintendent, who decides when it is necessary for the bearings of a car to be renewed.

After being repaired, each armature undergoes an insulation test; and before being put under a car it is also tested at full load by being run for a period of 15 minutes in either direction. This shows up any defects in the repairs, and insures it being in perfect working order when again put into service.

Controllers.—Controllers are all examined at the end of each day's work; all contacts are cleaned and thinly coated with vaseline, also adjusted or renewed as found necessary. The whole of the inside is kept perfectly clean, and the parts which require it are periodically coated with insulating compound, with the result that it is a very rare thing for a controller to give trouble.

Automatic Cut-outs.—These appliances from time to time gave considerable trouble on the road, and it was found advisable to calibrate them every time a car passed through the shops for overhauling. This has effectively dealt with that particular trouble.

Trolleys.—All trolleys are examined daily, while the poles are also tested for tension, and adjusted, if found necessary, once a month. Experiments have been made with several kinds of trolley wheel bushes, and one composed of solid graphite has been found to give the best results. The bush, wheel and spindle, has run 5,762 car miles, and although the wheel is nearly worn out, the bush and spindle are very little the worse; they can be put into, and will last the life of, a second wheel. The cost of the bush is 1s. 2d., compared with 1s. paid for the metal-cased graphite bush, of which two are required during the life of one wheel.

The protection of passengers from electric shock is an important matter, and to insure this as far as possible by the immediate detection of a leakage, ruby lamps are being used in the leakage circuit, so that they will not be confused with the platform lamps. All leakage lamps and circuits, also lightning arresters, are examined and tested at least once a month. Some undertakings have had their cars fitted with a patent "trolley earth indicator," which consists of a short-circuiting switch, held open by means of a fine wire fuse. This wire is connected in shunt with the switch, and as the whole apparatus is in circuit between the trolley base and earth, immediately upon the standard getting alive the fuse is melted and allows the switch to close by means of a spring. This connects the standard directly to earth, and causes an electric or mechanical bell to be set ringing.

Brakes.—The question of brakes is an important one on every undertaking, but where cars have to negotiate gradients of 1 in 11.5, and carry some of the heaviest rushes of holiday traffic over them, as in the case on the Nottingham system, it becomes a very important one indeed, and the writer considers that too much attention cannot be given to assure their being maintained in the highest possible state of efficiency. It is not proposed to discuss the merits or demerits of the various types on the market, but only to emphasize the importance of having motormen properly instructed in the best way to use the brakes at their disposal, and a systematic inspection and overhauling of such brakes by trained and competent men. Money so spent can be considered as a first-class insurance premium against accidents.

All the cars under the control of the writer are equipped with either a mechanical or magnetic track brake, in addition to the ordinary ratchet wheel brake, all of which are carefully examined nightly, and the necessary adjustments or renewals executed; in addition to this all the brakes of every car are examined and tested once a month, under the direct supervision of the works superintendent or his chief assistant. A number of the cars are fitted with an automatic adjusting device, for keeping the blocks set to the proper distance from the wheels. These are acting very satisfactorily and effect a saving in labor.

During the time the Nottingham electric system has been in operation, nearly four years, there has not been a single case of a car running away, which of itself fully justifies the great care that has always been bestowed upon this part of the equipment.

Wheels and Axles.—As to the vexed question of steel versus chilled iron wheels, sufficient has been heard of this recently to excuse a comparison of their merits being entered upon in this paper. Like many others, the writer has been experimenting with steel-tired wheels, but considerable difficulty has been caused by the flanges. Possibly this may be attributed to the fact that they have a large number of curves to negotiate. On one route of about three miles there are seven curves of a radius ranging from 45 feet to about 60 feet. Very good results have been obtained from chilled wheels, some having run upwards of 45,000 miles, the average life being 34,124 miles, and in only one case has a pair been trued up in the grinding machine. We have a good permanent way, which doubtless accounts to a large extent for our comparative freedom from the troubles connected with broken axles and wheel flanges.

For single truck cars the tendency appears to be in favor of increasing the size of the axles. This is undoubtedly a step in the right direction, as a much larger diameter might be used with advantage, not only for the additional strength, but also to obtain a larger bearing surface. The writer is not in a position to discuss the question of broken axles, having had but one failure in $6\frac{3}{4}$ million miles run by the cars.

Inspection and Reports.—To avoid as far as possible breakdowns on the road, and for assisting motormen who might be in difficulties, a motor inspector is stationed at a point on the system where all the lines converge. Defects reported to him are dealt with on the road, or the car changed if necessary, and a daily report of all such cases is made by him. He is in direct telephonic communication with each depot, which enables him to arrange for the changing of cars at the most convenient point. Definite instructions have also been given that under no circumstances shall a car be allowed to remain in service with its brake in the slightest degree defective. In addition to this, every motorman before going off duty enters in the report book at his depot particulars of any repairs requiring attention and attaches his signature thereto. Their reports are compared with that of the motor inspector, and a return of all repairs executed during the night is handed in to the works superintendent each morning.

General.—To enable a check to be kept upon the repairs bill, which, by its tendency to increase, appears to be always trying to take a more prominent place in tramway matters, also to decide upon the best methods and materials to be used in connection therewith, full and accurate records should be kept of all matters connected with the running, inspection and

repairs of the cars, as only by a careful study of these can the many points coming under consideration be adequately dealt with.

In conclusion the writer wishes to say he is afraid there is very little new, or of a substantial nature, contained in the paper, but feels that comparisons of the methods of working, and also the operating expenses of different systems, are always interesting if not conclusive. A manager whose system consists mainly of steep gradients has reason to feel envious of the low cost, to say nothing about the minimized risk of accidents, at which other systems can be operated whose routes are all practically level. Not only is the consumption of current much heavier with steep gradients, but the writer finds the cost of maintenance also increases in practically the same ratio. No conclusions, therefore, should be drawn from such comparisons, without taking into consideration the many different conditions under which the undertakings have to be operated.

Michigan's New Electrical Association.

The first annual meeting of the newly-organized Michigan Electric Association was held last week in Detroit, owners and managers of central station electrical plants and their superintendents from all over the State attending.

President Phillips called the two days' session to order and one day was taken up with reading papers and discussion. Prof. John R. Allen, of the University of Michigan, read a paper on "Steam Economies," and Prof. G. S. Williams, also of the University of Michigan, read one on "Water Power." The paper of E. R. Robert, of Pittsburg, on "The Nernst Lamp as a Factor in Commercial Lighting," brought out a lively discussion. F. W. Wilcox, of the General Electric Company, of Harrison, N. J., disagreed radically, and he was supported by Alexander Dow, vice-president and general manager of the local Edison Illuminating Company. Mr. Wilcox then read a paper on "Economies in the Practice of the Incandescent Lamp," the last paper of the session.

Proposals Invited.

The Bureau of Supplies and Accounts of the Navy Department at Washington, D. C., is inviting sealed proposals until November 1 for furnishing the navy yards at Mare Island and Puget Sound, and the naval training station at San Francisco, with a quantity of incandescent lamps, telephone switchboard, Weston ammeters, bracket fans and accessories, transformers, wire, lamp cord and miscellaneous electrical supplies. Blank forms and other information can be obtained upon application to the navy pay offices in San Francisco, Cal., and Seattle, Wash., or to the Bureau.

On November 8 the Bureau will open bids for furnishing the navy yards at Portsmouth, N. H., and Boston, Mass., with motor drives for various machines. Blank forms may be obtained upon application to the navy pay offices in those cities or to the Bureau.

The Bureau will also open bids on October 25 for furnishing the Boston and Newport navy yards with a quantity of incandescent and arc lamps, electric motors, switch boxes, wire, conduit and fittings, Thomson recording wattmeters, Weston voltmeters, dry cells, and miscellaneous electrical supplies. Blank forms may be had upon application to the navy pay offices in those cities or to the Bureau.

The Bureau will also open bids on November 8 for furnishing the Pensacola Navy Yard with electric blowers, recording wattmeters, weatherproof wire, etc. The Bureau will furnish blank proposals upon application.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCT. 11, 1904.

Electric Railways and Appliances.

771,922. Car Fender. John McGuire, St. Louis, Mo. Filed Aug. 5, 1903.

771,983. Insulated Joint. Percy Holbrook, New York City, assignor to the Weber Railway Joint Manufacturing Company. Filed Dec. 28, 1903.

772,008-009-010-011. Insulated Joint for Railroad-Rail Sections. George A. Weber, Stamford, Conn., assignor to the Weber Railway Joint Mfg. Co., New York City. Filed June 4, 1901, and Nov. 23 and 24, 1903.

772,087. Trolley. Henry B. Clarke, Chicago, Ill. Filed Nov. 9, 1903.

772,298. Trolley-Wire Support. William H. Spiller, Aurora, Ill., assignor to the Wilcox Manufacturing Company, same place. Filed Feb. 2, 1904.

772,321. Trolley. Perry Anderson, Sharpsburg, Pa. Filed June 20, 1904.

Electric Lights and Appliances.

771,907. Electric-Arc Lamp. Charles E. Harthan, Lynn, Mass., assignor to the General Electric Company. Filed March 11, 1902.

771,988. Incandescent Electric Lamp. Jesse R. Lovejoy, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 11, 1901.

772,215. Process of Manufacturing Glowers, Luminants and Filaments for Electric Incandescent Lamps. Francis M. F. Cazin, Hoboken, N. J. Filed March 2, 1903.

772,257. Electric-Arc Lamp. Ralph Scott, Wilkes-Barre, Pa., assignor of one-half to Marcus A. Miller, New York City. Filed Oct. 14, 1903.

Electrical Machinery and Apparatus.

771,802. Power Transmission. Victor S. Beam, East Orange, N. J., and Charles L. Clarke, New York City. Filed April 16, 1904.

771,820. Protecting Device for High-Frequency Apparatus. Lee de Forest, New York City. Filed June 9, 1904.

771,858. Commutator. John H. Brown, Reading, Pa. Filed Jan. 7, 1904.

771,891. Protective System for Electric Conductors. Leonard Andrews, Hastings, Eng., assignor to the Stanley Electric Manufacturing Company. Filed April 15, 1903.

771,932. Alternating-Current Meter. William H. Pratt, Lynn, Mass., assignor to the General Electric Company. Filed March 3, 1903.

771,958. Controller. Montraville M. Wood and Henry Geisenhoner, Schenectady, N. Y., assignors to the General Electric Company. Filed April 4, 1904.

771,987. Electric Crane. Harry A. Lewis, Norristown, Pa., assignor of one-half to Alan D. Wood, Conshohocken, Pa. Filed Dec. 30, 1903.

771,989. Electric Switch. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 19, 1897.

772,051. Indicator for Electric Snap-Switches. Charles G. Perkins, Hartford, Conn. Filed Oct. 15, 1903.

772,067. Electric Controller. August Sundh, Yonkers, N. Y., assignor to the Otis Elevator Company. Filed July 20, 1904.

772,083. Electric Motor. Edward Bretch, St. Louis, Mo. Filed May 11, 1903.

772,143. Electric Brake for Vehicles. Alfred Green and Fred A. Strall, Rochester, N. Y. Filed Sept. 3, 1903.

772,235. Electric Igniter for Explosive-Engines. William B. Hayden, New York City. Filed Feb. 15, 1904.

772,274. Transmission-Gear. Charles H. Day, Hornellsville, N. Y. Filed Oct. 16, 1903.

772,277. Current-Controlling System. Arthur C. Eastwood, Cleveland, O. Filed June 4, 1904.

772,313. Electric Controller. Arthur W. Harrison, Los Angeles, Cal. Filed Aug. 24, 1903.

Telephones and Telephone Apparatus.

771,853. Telephone Call-Recorder. Henry Abbott, New York City. Filed Aug. 17, 1901. Renewed March 7, 1904.

771,897. Call-Signal Apparatus for Telephone Exchanges. William W. Dean, Chicago, Ill., assignor to the Western Electric Company. Filed Jan 14, 1902.

771,946. Means for Supporting Telephone Receivers. Frank W. St. John, Coshocton, O. Filed April 27, 1904.

771,972. Telephone Toll-Line System. William W. Dean, Chicago, Ill., assignor to the Western Electric Company. Filed Jan. 14, 1902.

771,996. Measured-Service System for Telephone Exchanges. Frank R. McBerty, Evanston, Ill., and James L. McQuarrie, South Orange, N. J., assignors to the Western Electric Company. Filed Feb. 23, 1904.

772,023-024. Automatic Telephone Exchange System and Apparatus. Albert M. Bullard, New York City, and Louis A. Falk, Boston, Mass., assignors to the American Telephone & Telegraph Company. Filed Jan. 26, 1904; Feb. 12, 1904.

772,213. Electric or Telephonic Transmission. Henri Carbonnelle, Uccle, Belgium. Filed July 20, 1904.

772,310. Mouthpiece for Telephone Transmitters. Ira S. Ashe, Philadelphia, Pa. Filed June 18, 1904.

772,327. Cut-Out for Rural Telephones. Richard E. Pedigo, Lucas, Iowa. Filed April 23, 1904.

Miscellaneous.

771,818-819. Wireless Signaling Apparatus. Lee de Forest, New York City. Filed May 28, 1904.

771,908. Electric Heater. Harry E. Heath, Windsor, Conn., assignor to the General Electric Company. Filed Feb. 12, 1904.

771,920. Coin-Collector. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Jan. 23, 1903.

771,968. Electrostatic Instrument. Francis H. Bowman, Lynn, Mass., assignor to the General Electric Company. Filed Nov. 25, 1903.

772,002. Electric Clock. Theodore A. Schlueter, Oakland, Cal. Filed Feb. 7, 1903.

772,063. Glove-Former. George J. Schneider, Detroit, Mich., assignor of nineteen-twentieths to the American Electrical Heater Company. Filed Nov. 19, 1903.

772,086. Electric Elevator Apparatus. Eugene R. Carichoff, East Orange, N. J., assignor to the Otis Elevater Company. Filed July 29, 1903.

772,096. System of Electrical Distribution. Josef H. Hallberg, New York City. Filed Oct. 26, 1903.

772,102. Electroplating Apparatus. Willis R. King, New York City, assignor to the Hanson & Van Winkle Company. Filed Feb. 8, 1904.

772,190. Lightning-Arrester. Percy H. Thomas, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 6, 1903.

772,278. Electric Automatic Block-Signal and Safety System. George P. Finnigan, Greene, N. Y. Filed May 1, 1902.

772,288. Ventilated Coil for Electrical Apparatus. Newitt J. Neall, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Jan 20, 1904.

772,322. Feeder Protection. Leonard Andrews, Manchester, Eng. Filed Nov. 6, 1903.

THE TELEPHONE WORLD.

New Independent Lines in Wisconsin Indicate Continuation of Battle.

Superior's telephone war between the Bell and the People's Telephone Companies, promises to grow more bitter now, as it is claimed that the Independent company is getting in better shape to make a fight for the telephone business of the city. The Independent company has had low rates and exclusive connections with the city hall as its means of keeping up the fight against the older company, while the other one has had the Independent line there beat on the matter of long distance connections.

The Independent company is continually getting new long distance connections, and it was announced lately that connections of great importance to the city, would be made within the next 60 days by the company. The company now has connection with the Twin Cities and La Crosse.

The Independent telephone companies of Wisconsin are building a line from Racine, on Lake Michigan, to the Mississippi River, which will give Superior long-distance connections with Racine, Kenosha, Madison, Janesville and Prairie du Chien, together with other important points in the State. This is expected to give the Independent concern a better foothold than ever throughout the State.

Tullahoma, Tenn., is to have a new telephone company. It will be a home concern, Independent, composed entirely of home capital. This comes about, it is stated, because of what is termed the unreasonable exactions on the part of the Cumberland Telephone Company. There is, and has been for a long time, much complaint of the high rate of charges made by the Cumberland Company, until the people have tired of the matter, and have concluded to have "one of their own." The stock has all been subscribed and parties interested in the enterprise will go right ahead.

Articles of incorporation have been filed by the Schooler Brothers' Telephone Company, the corporation recently granted a franchise to build and operate a telephone exchange in South McAlester, I. T. Mayor H. H. Keller is president of the company, and holds two shares at $25 each. The Schooler Brothers control the majority of the corporation's paper. The capitalization was for $100,000, with $65,000 subscribed.

The citizens of Southside, Tenn., have commenced making plans for the establishment of a telephone exchange. The telephone service there is now supplied from the Clarksville Exchange of the Cumberland Company.

The long distance service of the Co-operative Telephone Company has placed Detroit, Mich., merchants in touch with thousands of customers who are not subscribers to the Bell service.

The new telephone line connecting Markham with El Campo, Tex., has been completed. The company will open offices in Midfield and Danevang in that State.

Telephones a Benefit to the Deaf.

The Congregational church at Sherburne, N. Y., and F.L. Shepard, superintendent of the Utica Telephone Company, have been experimenting with a system to enable the aged and deaf to hear the services distinctly. It consists of a specially constructed transmitter, placed near the pulpit and choir, and connected by wire with the pews, where a receiver is to be used by those who are hard of hearing.

The Columbia Telephone Company, with headquarters in Hudson, N.Y., is branching out now for business on the opposite shore of the Hudson River, and to get it and make connections with other home companies a cable was laid across the river at Hudson. The land connection was made at the city dock, and the cable, which is over an inch in diameter, was played out from reels which had been placed on a lighter.

The Huntingdon, Pa., and Clearfield Telephone Company has completed its new line to Gillintown, where connection was made with the United Telephone Company. This will give the patrons of the former company connection over two pairs of wires with Bellefonte, Lock Haven, Williamsport, Tyrone, Altoona and intervening points, a service that will be very greatly appreciated.

The Inter-State Independent Telephone & Telegraph Company of Peoria, Ill., will construct a new exchange building to cost $30,000. The building will be three stories in height and the telephone company will require most of the space to house its equipment properly. The basement will be used as a storeroom, to which purpose also the 71 feet in the rear of the first floor will be devoted. The second floor will contain the cable-room and power plant, the wire chief's office, in which testing machines are installed, a lunch room for the operators, and the local offices of the company. The third floor will be entirely given over to accommodation of a switchboard.

The New York Telephone Company & New Jersey Telephone Company, put a new schedule of toll rates into operation on October 1, by which a general reduction, over their whole territory, of about 20 per cent. went into effect.

Frederick A. Wegner, of Detroit, has asked the Woodmere, Mich., council for a telephone franchise to operate in that village. His prices will be $48 a year for telephones in business places and $30 for residences. The matter was referred to the committee on ordinances.

The Common Pleas Court, of Cincinnati, O., has reversed the action of the Probate Court in giving grants and franchises to Independent telephone companies.

C. J. Wood, of Utica, N. Y., promoter of the Canastota Telephone Company, announces that work on the system, which the company propose to establish in Canastota, will be begun about November 1.

Melbourne, Ark., has two Independent telephone lines, and will soon have another.

Iowa Shows Increase in Telephone Mileage.

The mileage of telephone lines in Iowa increased three and a half times during the past year, whereas in 1903 it was 14,043 miles; in 1904 it was 48,491 miles.

The principal increase was in the rural lines. This is the reason that the assessment recently made by the executive council did not keep up proportionately with the mileage increase.

The total of the assessment of the past year was lately announced, the footings of the extensive assessment sheets having been made. The property was valued at $8,808,126.76. This includes telegraph lines also.

Last year the council valued the lesser mileage at $7,797,487.16. This increase of $1,010,539.60 represents the increased mileage of the simple rural lines.

The Altoona, Pa., & Logan Valley Railway Company will shortly install an Independent telephone system along its own lines, using its own poles and wires. There will be numerous stations established along the route so that in the event of an accident the conductors can readily place themselves in communication with the power house of the company.

The Hastings Independent Telephone Company with H. H. Hendon, N. E. Batty, J. N. Lyman, G. F. Keefer and G. H. Platt as incorporators, has filed articles of incorporation with the Secretary of State. The concern has a capital stock of $30,000, and will operate telephone lines in Adams County, Neb.

From present appearances it seems that the Mississippi Telephone Company has declared war on the Bell system and has put a plan on foot by which it will gain the supremacy in Burlington, Ia.

The Northwestern Telephone Company of Valparaiso, Ind., has increased its capitel stock from $15,000 to $50,000.

Telephone Incorporations.

The Pewaukee & Sussex Telephone Company, Pewaukee, Wis. Capital stock, $2,500. Incorporators: A. T. Larson, S. E. McDowell and William Parker.

The Oil Belt Telephone Company, Norwalk, O. Capital stock, $25,000.. Incorporators: Harry E. Graham, C. M. Graham, E. N. Graham, Adelbert Graham and Joseph R. McKnight.

The Woodland Telephone Company, Manchester, Me. Capital stock, $10,000.. Officers: President, F. S. Collins; treasurer, J. T. Collins.

The Boston Valley Telephone Company, Patchin, N. Y. Capital stock, $2,000. Incorporators: L. G. R. Whiting, John W. Gasper, Patchin and F. A. Wurtz, Boston, N. Y.

The Edmonstone Company, New York City—to manufacture telephones and appliances. Capital stock, $100,000. Directors: Bouton Thompson, D. M. Miers and J. E. Ruston.

The White Plains Telephone Company, White Plains, Ky. Capital stock, $2,000. Incorporators: W. N. Bailey, L. H. Johnson and R. P. Teague, of White Plains.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Amory, Miss.—The Amory Light & Power Company will erect a new electric light plant, which is to be completed for use by January 1.

Burlington, Ia.—An effort is being made to establish an electric light plant at Burlington Junction.

Chester, Ill.—The Chester Light & Ice Plant has been incorporated with a capital of $10,000 to operate an electric light plant and cold storage plant. The incorporators are Harvey Neville, L. H. Glister and others.

Clyde, Kan.—M. E. Maggart, of Chicago, will begin preparations for the building of an electric light plant here about November 15.

Creston, Ia.—The city council has received a proposition from M. S. Mordant, who desires to put in an electric, gas and heating plant. The question will be voted on at the coming election.

Eupora, Miss.—This town is to have an electric light system furnished by a private corporation. The improvement represents an investment of about $10,000.

Florala, Ala.—This town will have an electric light plant and waterworks system soon.

Foreman, Ark.—Messrs. H. N. and E. P. McIver are making arrangements to establish an electric light plant here.

Freeport, Ill.—At a recent city council meeting the arrangements between this city and the Freeport Railway Light & Power Company for the lighting of the alleys here was approved at the contract bid.

Litchfield, Ill.—The city council has granted a franchise to Charles Munday, Jr., to construct and maintain an electric light and gas system here.

Lockport, N. Y.—The common council has unanimously voted a franchise to the Niagara, Lockport & Ontario Power Company to use the streets for furnishing electric light, heat and power.

Marshall, Mich.—The common council in a special meeting gave the electric light commissioners authority to install the machinery for a new system of alternating current street arc lights to replace the old lamps, which have been in use since 1890. The change will cost $2,800,

Morrisville, N. Y.—The electric light plant is to have a new 100 hp. engine.

New Castle, Del.—The Delaware Water Improvement Company, of this place, has been formed to conduct power water works and an electric light plant here with a capital of $150,000.

Petros, Tenn.—A. H. Woods, manager of the Big Brushy Coal & Coke Company contemplates putting in a fine electric plant in his mine in the near future.

Roswell, N. M.—The electric light plant here was damaged by a recent flood.

Saginaw, Mich.—The city council has received petitions asking for additional arc lights to be placed at various street corners in the town for better lighting purposes. This matter is to be discussed at the next meeting of the board.

Selinsgrove, Pa.—C. E. Pugh has been granted permission to construct an electric light system here.

Silver City, Miss.—A stock company has been organized, known as the Citizens' Electric Light, Water & Manufacturing Company. An electric light plant is to be erected.

Sloan, N. Y.—Arrangements have been made with the Depew & Lancaster Light & Power Company for the electric lighting of this village.

Spring Lake, Mich.—The citizens of this village have voted in favor of installing an electric light plant.

Sturgis, Mich.—See Hincher, of the Hincher Manufacturing Company, of Burr Oak, is investigating the matter of different private electric lighting plants in the factories here with a view to installing such a plant in his factory soon.

Syracuse, N. Y.—The Syracuse Lighting Company has voted to install a new battery of boilers in the electric light plant, to cost $25,000. Ceylon H. Lewis is president.

Thermopolis, Wyo.—The plant of the Thermopolis Electric Light Company was lately destroyed by fire. The plant will be rebuilt at once.

STREET RAILWAYS.

Albany, N. Y.—The Ithaca & Cayuga Heights Railway of Ithaca was lately incorporated here to operate an electric street railroad 2 1-5 miles long. Its capital stock is $50,000, and dire tors J. T. Newman, C. H. Blood and C. H. Hull, all of Ithaca.

Appleton, Wis.—The Outagamie County Traction Company, which will soon operate a 20-mile interurban road between this city and Seymour, will abandon the gasoline feature in favor of the trolley line. Milwaukee and Chicago capital is interested in the new project.

Chattanooga, Tenn.—The amount of $25,000 has been subscribed by citizens here to build an electric railroad up Lookout Mountain. It is said that the proposed electric road up the mountain will not be built in opposition to any line or lines, but that as a matter of self-protection to the interests of the mountain and the Inn it is necessary to build an electric line.

Decatur, Ill.—The Bloomington, Clinton & Decatur Electric Railroad Company has been incorporated, with a capital of $50,000, by L. R. Murphy, T. R. Leavitt and others.

Dubuque, Ia.—A new electric line is proposed to be built between here and Plattville, Wis. Capt. C. A. Weeks, of Chicago, is one of the promoters.

Forreston, Ill.—The city council has granted a franchise to the Freeport-Dixon Interurban Electric Line for the construction of a line here.

Fort Smith, Ark.—Lately there was completed here the organization of the Mount Mena Traction Company. The officers are: Alfred Bissell, president; E. J. Mills, vice-president, and James L. Hale, secretary and treasurer. The capital stock is $50,000. It is proposed to build an electric line from Rich Hill, on the Kansas City Southern, to Mount Mena. The route is a short one, but the altitude to be reached is 3,000 feet. The line is to be completed and ready for operation by next summer.

Grand Island, Neb.—The Commercial Club is interested in the construction of an electric line connecting this city with the territory west of here.

Guthrie, Okla.—John Shartel, of Oklahoma City, proposes to build an electric interurban road between here and Oklahoma City.

Jackson, Miss.—The Jackson Electric Railway Company will at an early day begin a $60,000 extension of its lines.

New Richmond, Wis.—Burnett County and Northern Polk County citizens have determined to have a railroad. It is proposed to build an electric line from here to Yellow Lake, Burnett County, by way of Balsam Lake, the county seat of Polk County.

Port Huron, Mich.—The City Electric Railway Company was lately granted permission to construct a line on the city property.

Red Oak, Ia,—The Red Oak Electric Company has been granted the right of way for the construction of its new electric line.

Sandusky, O.—J. C. Parker, who has been promoting the Sandusky, Clyde, Tiffin & Southern Electric Railway, has secured a right-of way for a branch line to run from Ransom's Corners to Fremont, 15 miles, thus giving a direct line between Fremont and this city. It is expected that the new road will soon be financed.

Sharpsville, Pa.—Pittsburg and Cleveland capitalists have organized a company and will build an electric street railway from here to Conneaut Lake, a distance of 50 miles. The company, which is headed by W. H. Walker, of Cleveland, and C. G. Hussey, of Pittsburg, is capitalized at $1,000,000,

South McAlester, I. T.—Col. W. Bean is the promoter of a new electric railroad to be built here.

Wellington, Kan.—L. H. P. Northrup, the electric railroad promoter, was recently granted a 50-year franchise with the city to operate an electric road.

Woodville, Miss.—The Woodville-Fort Adams Electric Railroad Company is the name of a new company just organized here, with L. T. Ventress as president.

POWER PLANTS.

Jackson, Tenn.—The Jackson Light & Power Company, composed of prominent citizens, will erect an up-to-date power plant as soon as its franchise is received.

Silverton, Col.—Arrangements will be made toward the installation of an electric power plant at the Highland Mary Mine. The power to generate the electricity that is to be distributed in mine and at the mill comes from the excellent water supply at the head of Cunningham gulch. The motor capacity of the new plant will be 250 hp., and the equipment is to be large enough to carry on heavier operation. G. M. Seeley, the new superintendent, has in view several improvements that future development and output of mine may warrant from time to time.

BIDS WANTED.

Harrisburg, Pa.—Sealed proposals will be received at the office of J. M. Schumacher, superintendent of grounds, until November 15, for furnishing electric light and power for the new Capitol Building and a number of other buildings.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 13@13¼c.; Lake 13⅛@13⅜c.; casting, 12⅞@13c.

The Chicago Edison Company has declared the regular quarterly dividend of 2 per cent., payable November 1.

The Oklahoma Gas & Electric Company of Oklahoma City has made a mortgage to secure $1,000,000 bonds for betterments.

A. B. Cleveland, of Unionville, O., has been appointed receiver for the Cleveland, Painesville & Ashtabula Electric Railway Company.

The United Electric Light & Power Company of Baltimore has declared a dividend of 2½ per cent. on its preferred stock, payable November 2 to holders of record October 25.

The stockholders of the United Gas & Electric Company, of New Albany, Ind., have authorized a bond issue of $1,500,000, one-half for refunding and the rest for extensions.

The Automatic Electric Company of Chicago has declared the regular quarterly dividend of 2 per cent., payable November 1. Books close October 26 and reopen November 2.

The Underground Electric Railways Company, Ltd., of London, Eng., applied to the New York Stock Exchange to list $16,550,000 five per cent. profit-sharing secured notes of 1908.

The United Electric Securities Company of Boston has declared a semi-annual dividend of $3.50 a share on its preferred stock, payable November 1 to holders of record October 20.

The directors of the National Carbon Company will meet in Cleveland next week to take action on the usual quarterly 1¾ per cent. dividend on the preferred stock, payable November 15.

It is well known that the great mass of Brooklyn Rapid Transit stock is closely held by a dozen men, who are always ready to turn it over in the market if they can do so without losing much stock.

The Chicago Edison Company has sold at private sale $500,000 of its first mortgage gold 5 per cent. bonds. This issue brings the total of the company's outstanding bonds to $5,500,000. The authorized issue is $6,000,000.

After providing for the dividend on the preferred shares of the Cuba Submarine Telegraph Company, Ltd., the London directors have declared a dividend at the rate of 5 per cent. per annum on the ordinary shares free of income tax.

The present market value of Massachusetts Electric shares at 56 for the preferred and 13 for the common, is $13,370,000, or about one-half the market value at the highest prices of 1902. Actual control of the properties is selling for less than $4,000,000.

Advices from Pittsburg state that the control of the Philadelphia Company, the gigantic corporation which operates the street railways and electric lighting systems of Allegheny County, Pa., has passed to the United Gas Improvement interests of Philadelphia.

The reorganization committee has extended the time for making deposits of the securities involved in the plan of reorganization of the Lehigh Valley (Pa.) Traction Company system until November 1 inclusive, after which no deposits will be received except under such penalties as the reorganization committee may prescribe.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Oct. 17
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	158⅝
Metropolitan Street Railway	122⅛
Metropolitan Securities	84
Ninth Avenue	197
Third Avenue	128¼
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	66⅝
Public Service Corporation (New Jersey)	104
Philadelphia.	
Consolidated Traction of New Jersey	75
Philadelphia Traction	97⅞
Union Traction	56
Boston.	
Boston Elevated	154⅛
Massachusetts Electric Companies, com	13½
do. do. do. pref.	55½
West End Street, com	91
do. do. do. pref.	110
Chicago.	
City Railway	175
North Chicago	71
Union Traction, com	7⅜
do. do. pref.	36

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

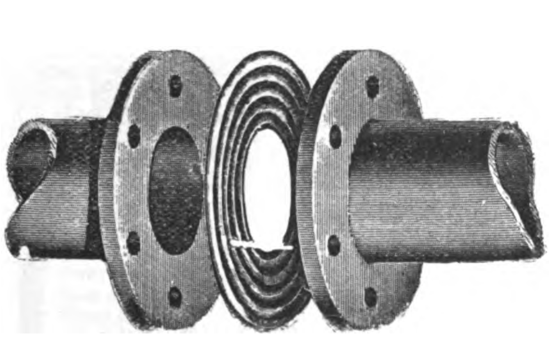
New York City.	
Allis-Chalmers, com	12
do. pref.	50½
Electric Boat, com	40
do. do. pref.	73
Electric Lead Reduction	½
Electric Vehicle, com	16
do. do. pref.	23
Westinghouse, com	168
do. pref.	190
General Electric	175½
Boston.	
Edison Electric Illuminating	250
General Electric	175
Westinghouse Electric & Mfg., com	83½
do. do. do. pref.	95
Chicago.	
Chicago Edison	158
National Carbon, com	37
do. do. pref.	110
Philadelphia.	
Electric Company of America	9⅜
Electric Storage Battery, com	70½
do. do. do. pref.	70¾

TELEPHONE AND TELEGRAPH STOCKS.

Boston.	
American Telephone & Telegraph Company	143½
Western Telephone Company	18½
New England Telephone Company	132¼
New York.	
American Telegraph & Cable Company	93
Commercial Cable Company	210
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	148
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92¼
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..

MISCELLANEOUS STOCKS.

Otis Elevator Company	40
Consolidated Car Heating	64
Standard Underground Cable	200



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CONTENTS.

EDITORIAL NOTES.

Chemistry, a Department of Electricity?

The subject of static electricity abounds in interesting scientific possibilities. Recent discoveries have shown an amazing state of affairs as far as the subdivision of atoms is concerned. Further light is cast on the subject by the discovery of the presence of an elementary charge in the ultimate particle of matter. This exercises so great an influence over its relationship to the atom that by some it is even thought to be merely an electric charge, which, in one phase of its operations is matter, and in another phase electricity.

A review of the facts leads us to the belief that all forms of matter are inextricably associated with static electricity: that a modification in the physical conformation of a mass of matter is due to electrical changes which give rise to many of the effects familiar to laymen and scientist alike. In addition, the chemical changes which occur, in the form of violent reactions or slow processes of decomposition, are inherently electrical in character and in many instances, where scientific analysis has paved the way, might be anticipated in a purely mathematical and electrical manner.

Chemistry, then, is becoming a subject in which a new atom is taking the place of the old. The atom of Dalton is being replaced by a center of electrical energy in a state of intense rotation and vibration. In fact, instead of the old atom we are face to face with an infinitesimal planetary system. That which has hitherto been regarded as merely matter, now appears as identical with electricity. We have Ramsay, Crookes, Van T'Hoff and Arrhenius, the greatest chemists and electro-chemists in the world, to point out on the scientific horizon the new world of chemistry, toward which the tide of thought is rapidly setting.

To consider a charge of electricity concentrated on a point of matter of the most minute proportions, is to realize that a center of electrical attraction has been created to which the action of a pith ball to a charged glass rod is as light and delicate as the down on a butterfly's wing. Charges thus concentrated become centers of powerful attractive forces, and the simplest experiments in chemistry have thus far strongly proven that chemical affinity and valency, the last particularly, are due to just such a condition of affairs —electricity associated with the atoms. This, then, brings us back to our original question, in which we ask, is chemistry a department of electricity?

* * *

Losses of Energy on Trolley Lines.

Among the various questions of practical importance to those responsible for the operation of electric trolley lines, which came before the recent annual convention of the Municipal Tramways Association at Liverpool, England, was that of economy of consumption of current in operating cars. Everywhere, of course, the conversion of a horse railway to electrical working has been followed by a great reduction in working expenses, and in the very fact that this is such a common result there is found, by some, a cause for fear that managers and engineers may be content with the economy so effected and may not think it really necessary to make still further reductions, which as a matter of fact could be effected often enough with little effort by the adoption of an enlightened policy capable of accommodating itself to the various developments that are being registered from time to time.

A canvass recently made among the of-

ficials of English trolley lines by Mr. Peter Fisher, of the Dundee City Railways, has resulted in the bringing together of a great deal of interesting data, the general tenor of which indicates that the question of effecting economies is now being kept constantly in mind by many of those to whom he sent a set of queries. We will not enter in detail into these queries nor into the various replies, though they were given as an appendix to the paper which Mr. Fisher read at Liverpool. Some of the directions in which he considers that losses of energy may be prevented may, however, be touched upon. If the voltage of the line is allowed to drop below the pressure for which the car motors are wound serious losses are caused. It is found that with a drop of 20 to 40 volts the energy required has increased by from 5 to 15 per cent. The equalizing of pressure on the two lines should be effected by cross-bonding the overhead work wherever possible. It has sometimes been observed on hilly routes that a considerable drop in potential exists between the wire supplying the ascending cars and that used for those descending. Several methods are in use having the same object in regard to this matter. In Glasgow the overhead work is bonded at one or more places in each section; in other towns a jumper is used where gradients exist. There is, of course, the drawback that cross-bonding may give rise to both lines being rendered unserviceable because of a fault on one.

So far the evidence obtainable respecting efforts which have been made to economize current by a more rapid acceleration is quite conflicting. In some places material reductions in the consumption are recorded, but from others comes a distinctly opposite report. Mr. Fisher made certain experimental runs at Dundee, and he found that a more rapid acceleration showed a saving of approximately 20 per cent. in current consumption.

Lately British trolley line authorities have shown that they regard the motorman as a factor of some considerable consequence in the economical use of current. Some men operate their cars in a more intelligent and careful manner than others do. While one man brings his car to a standstill at the various stopping places with but little effort, the next man approaches the same place pulling for all he is worth at the brakes, and, of course, wastes current. A system of instruction by special inspectors in the more economical operation of cars is in vogue in some places, but a practice which is coming more into vogue is to give a bonus to the motormen who manage to keep their current consumption per car mile below a specified figure.

A rail with a greasy surface is of course wasteful in current, for it neither allows the wheels to get a good grip nor does it provide a good return path.

Among other causes of a loss of current on a trolley system may be the following: Bad controller contacts, badly fitting motor brushes, badly fitting brakes, lubrication, friction on armature and axle bearings, the gauge of wheels, and the fixing of stopping places on an up-grade or on a curve.

The item of electrical energy stands at a high percentage of the total working expenses of a line, and the foregoing are a few directions in which it is thought possible that some reduction might be effected.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Directors of the Interborough Company of this city have arranged for a notable banquet to be given at Sherry's to-morrow, October 27, in commemoration of the opening of the subway.

It is announced that within 60 days apparatus for wireless telegraph communication between Boston, Providence, New Haven and New York will be in operation. The American De Forest Wireless Telegraph Company is the projector.

Prof. Harry E. Clifford has been appointed acting head of the department of electrical engineering at the Massachusetts Institute of Techology, vice Dr. Louis Duncan, resigned.

The 190th meeting of the American Institute of Electrical Engineers will be held Friday evening at 8 o'clock at the Chemists' Club, 108 West 55th street, New York. The following papers will be presented for discussion: "The Telautograph," by James Dixon, and "The Transposition of Electrical Conductors," by F. F. Fowle.

A proposition has been made in Cleveland, O., by Thomas Fitzsimons to convert the city's sewage into electric light, and was favorably received by the board of public service.

The pyrhiliophor, or sun machine, the invention of Rev. M. A. G. Himalaya, a young Portugese priest, has succeeded at the St. Louis World's Fair in generating more than 7,000 degrees of heat (Fahrenheit). Aside from many interesting scientific deductions, which subsequent daily experiments confirmed, the inventor says he has made the following new discoveries: First, the heat of the sun is absolutely of electric origin; second, the intensity of the rays that produce the solar radiation is very much higher than that of the electric arc; third, the sun machine discloses from whence comes the electric energy which holds between the heat of the sun and the stars; fourth, it gives a glimpse of a way to directly transfer the rays of the sun into electric energy. This is the fourth sun machine Father Himalaya has erected. The first three were built at Lisbon and Paris.

On the Nebraska division of the Union Pacific Railroad motor cars are to run between Omaha and local stations. They will carry 30 people each and will be capable of 60 miles an hour.

Nine Allis Chalmers engines, each double the size of the prize winning "Big Reliable" at St. Louis, will operate in the subway of this city.

Stephen Dudley Field, the electrical engineer and inventor, in speaking of his amplifier says: "There is almost no limit to the sensitiveness of the instrument. Electricians have hitherto regarded the telephone as the most sensitive receiver, but the amplifier rivals it. It is intended primarily for use with submarine cables and as a substitute for the 'siphon recorder' now employed. With the older cables about 16 or 18 words a minute can be sent in one direction simultaneously by the 'duplex' system and 30 with the best and latest ones." In his laboratory, under conditions similar to those of actual ocean service, he says he has obtained a record of 32 words on a paper tape. He believes that this performance can be improved, and that with high speed will be associated greater accuracy.

An electric light plant is to be constructed at Auckland, New Zealand, at an estimated cost of about $375,000.

M. Octave Chanute thus forecasts the future of the flying machine: "The machines will eventually be fast, but they are not to be thought of as commercial carriers. To say nothing of the danger, the sizes must remain small and the passengers few, because the weight will, for the same design, increase as the cube of the dimensions, while the supporting surfaces will only increase as the square. The power required will always be great —say, something like 1 hp. to every hundred pounds of weight, and hence fuel can not be carried for long single journeys."

NEW SWISS ELECTRIC RAILWAY.*

A light electric railway, connecting Palezieux, Chatel-St. Denis, Bulle and Montbovon, has recently been completed, and was described in the *Schweizerische Elektrotechische Zeitschrift* of August 20. As may be gathered from the accompanying map, the route traversed by the line in question, which is 29 miles long, lies in a mountainous district, the altitudes of some of the principal points of the line being as follows: Palezieux, 2,200 feet; Semsales, 2,820 feet; and Estavennes, 2,330 feet. The maximum gradient of the line is, nevertheless, not very excessive, being 3.21 per cent. The track is built partly on existing roads and partly on its own ground. Of the bridges which had to be erected, the two principal ones are 80 feet and 105 feet long respectively. There are also two tunnels, one 655 feet, the other 328 feet long, both lying on curves of 328 feet radius. These curves have the smallest radius of any in the line, and a straight length of about 90 feet, equal to the length of an ordinary train, is built between any two curves. The gauge is 1 meter, and the rails, which are in lengths of 12 meters (39 feet), rest on wooden sleepers impregnated with a solution of zinc chloride. Where the permanent way has been especially built, rails of the vignoles type weighing 48 lbs. to the yard are used, while in other portions of the line, and particularly where the railway traverses inhabited places, grooved rails of the tramway type weighing 80 lbs. to the yard are made use of. The line is single with passing places at the stations, and is worked with continuous current at 750 volts.

Electric energy for working the system is generated as three-phase current at 8,000 volts in two water-power stations, the combined capacity of which is 10,000 hp. It appears, however, that one of the generating stations only—i. e., the one situated at Montbovon—is intended to supply the line in normal conditions, the other station, at Hauterive, being apparently considered as a stand-by. For converting the high-tension three-phase current to a continuous-current, a number of sub-stations have been erected along the line. Three of these, situated in Chatel-St. Denis, Semsales and Albeuve respectively, are equipped identically, each having two 90 kw. motor generators, which supply continuous current at between 750 and 1,000 volts. A fourth sub-station is to be built in Bulle, and will, when completed, contain two 170 kw. converting sets. In the case of the three small sub-stations, the high-tension three-phase current is first transformed down to 500 volts before being led to the motors, but in the case of the sub-station at Bulle, the motors are to be supplied directly by current at 8,000 volts. In the first three sub-stations alluded to, an accumulator battery, consisting of 375 cells of a capacity of 115 ampere-hours, is directly connected across the terminals of the continuous current generator, no cell switch being used. As a rule, the feeders are carried by the poles which support the overhead equipment. The feeder between Chatel-St. Denis and Semsales consists of two wires of a diameter of 11 mm. (0.432 inch); that between Semsales and Bulle of one 9 mm. (0.354 inch) wire; that between Bulle and Albeuve of one 8 mm. (0.315 inch) wire, and that between Albeuve and Montbovon of one 6.7 mm. (0.264 inch) wire. Every third or fourth pole is fitted with a lightning arrester. Double petticoated insulators support the feeders at heights varying between 24½ feet and 26 feet above ground. All poles are of impregnated wood, spaced from 65 feet to 130 feet apart. They are 33 feet in length, of which about 6½ feet is let into the ground; they carry iron brackets, from which the trolley wire is flexibly suspended, the distance between trolley wire and pole being nearly 7 feet. The trolley wire has a diameter of 9 mm. (0.354 inch), and is trebly insulated from earth. At stations, crossings and wherever the line runs along the road, the trolley wire is fixed at a height of 21.3 feet above the rails, but on special track the height is reduced to 18 feet, and in tunnels it is only 14.75 feet. Connection between the trolley wire and the feeder running parallel to it is made about every quarter of a mile, and section switches are inserted into the trolley line approximately every 1,100 yards. Current returns by way of the rails, which are cross-bonded every eighth of a mile.

At present the rolling stock consists of 10 motor cars and a number of trailers; there is also a number of 10-ton goods wagons. Current is conveyed from the overhead line by aluminum bow collectors, two of which are fitted to each motor car. Eight of the 10 motor cars are equipped with four 35 hp. motors, and are capable of running trains weighing 47 tons at a speed of 12.4 miles per hour on the maximum gradient of 3.21 per cent. Goods trains, weighing anything up to 60 tons, may also be handled by these motor cars, but, of course, at a correspondingly slower speed. Two motor cars have been fitted up with four 80 hp. motors, which suffice to haul a train up to 130 tons at a little over 10 miles an hour on the gradient already mentioned. Two motors are, in all cars, permanently connected in series, and are treated as a unit. A single reduction gear is used for transmitting the power from the motors to the car axles. Speed regulation is effected on the series-parallel system, and brakes of both the electric and pneumatic

Fig. 1.—Map Showing Palezieux-Bulle-Montbovon Electric Railway.

*From the "Electrician," London.

type are provided. The electrical part of this railway undertaking was carried out by the Elektrizitats-Gesellschaft Alioth, Bale, Switzerland.

MOTOR DRIVEN PUMPS.

ARTICLE III.

BY W. H. WAKEMAN.

(*Concluded.*)

A centrifugal pump draws water into its casing and discharges it from the same in very much the same way that a blower takes in and discharges air, consequently its internal parts do not cause friction because the blades do not touch the casing. From this it will be plain that impure water can be handled by a pump of this kind without material injury, so long as a strainer on the end of the suction pipe prevents debris from entering.

This is a valuable feature where an abundance of impure water is available for operating a surface condenser as described in the previous article, where water is circulated through the tubes to condense exhaust steam. As the water resulting from this condensation is used for boiler feeding none of the impurities circulated through the condenser contaminates this water, therefore the plan is satisfactory.

A centrifugal pump is sometimes driven by a belt from a countershaft, but this is not always convenient, because the pump may be wanted when the main engine is not running, when water from it is used for miscellaneous purposes. To overcome this objection a small engine is installed and a belt on its flywheel is carried directly to the pump. This is satisfactory, except where it must be located a long distance from the boilers, in which case the loss by condensation in the steam pipe is excessive.

If the engine is connected directly to the pump and both are located on one base it makes a compact machine, but the engine must be adapted to high speeds. A far superior plan is illustrated in Fig. 7, in which a motor is used to drive the pump by direct connection. This admits of locating the machine in any convenient place regardless of boilers, shafting or anything else, except to put it where the most efficient service will result. The rheostat can be located in the engine room while the motor and pump are several hundred yards distant. This makes it possible to operate the machine from a distant point, thus saving the time necessary to go to and from it.

It only needs a trip through the brick yards but a few miles from where this is written to understand the great utility of such a device. There is one steam

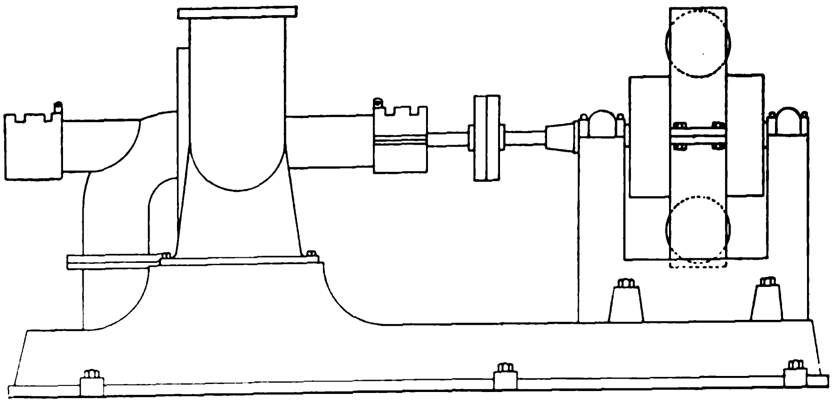

FIG. 7.

plant near the kilns where one or more brick-making machines are located, while another engine and boiler are placed near the clay pit, as it fills with water during the winter, and must be pumped out every spring by means of a centrifugal pump. After every heavy rain the pump is brought into service, and sometimes it is used between these periods to remove surface water which, of course, is always

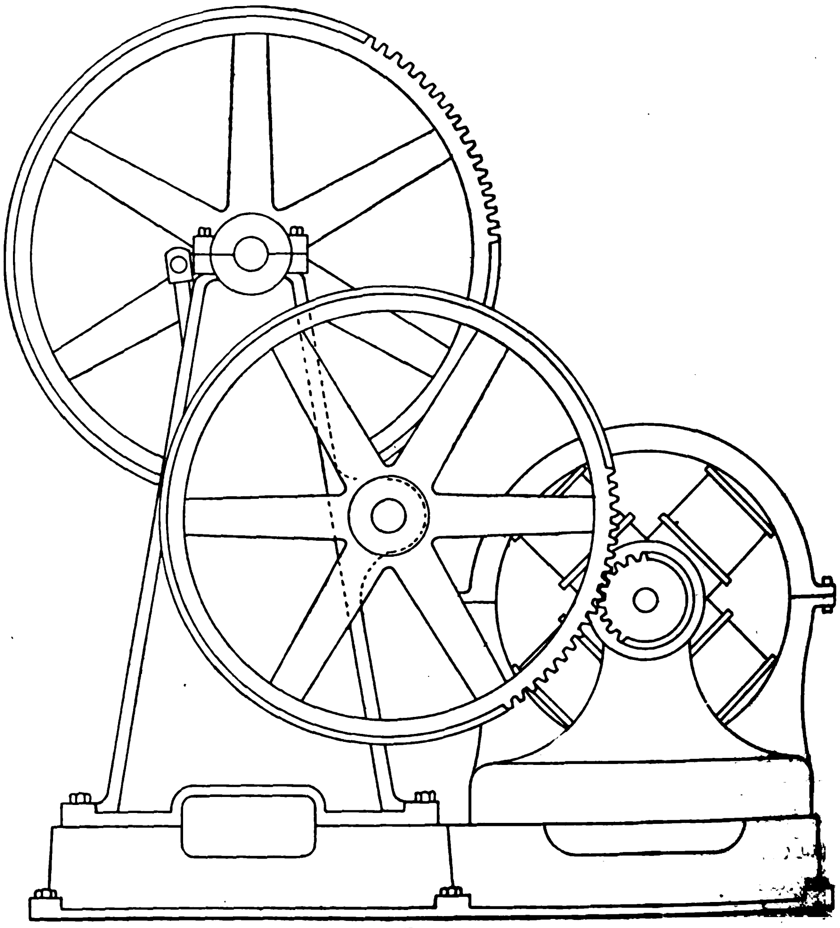

FIG. 8.

full of earth in suspension, so that it would soon ruin a piston pump.

As a boiler and engine used in this service is located in a shanty, and never receives even ordinary care, their condition at the end of five years can be imagined but not described. If a motor driven centrifugal pump is substituted, it will not only do the work with less attention than a small steam plant, but at the end of the brick-making season the whole outfit can easily be loaded on a wagon and stored in the barn until wanted for another season.

Fig. 8 illustrates the top gear of a deep well pump, driven by a motor. This does not necessarily mean that it is located at some distant point, as it may be used to draw water from an artesian well close to a central electric station, or for a manufacturing plant. It is a good idea to make these gears extra heavy, as they may act as balance wheels, thus protecting the motor from shocks and jars due to action of the pump.

Fig. 9 shows a close belted air pump of the horizontal type, driven by a motor. This is not intended for use in connection

with a condensing engine, but to supply compressed air for various uses in a large public building. A novel feature of this air pump or compressor, is that it has no inlet valve in the suction pipe, for the piston passes over an inlet port at about mid-stroke, which action prevents air from going back into the suction pipe.

Fig. 10 is a triplex horizontal pump

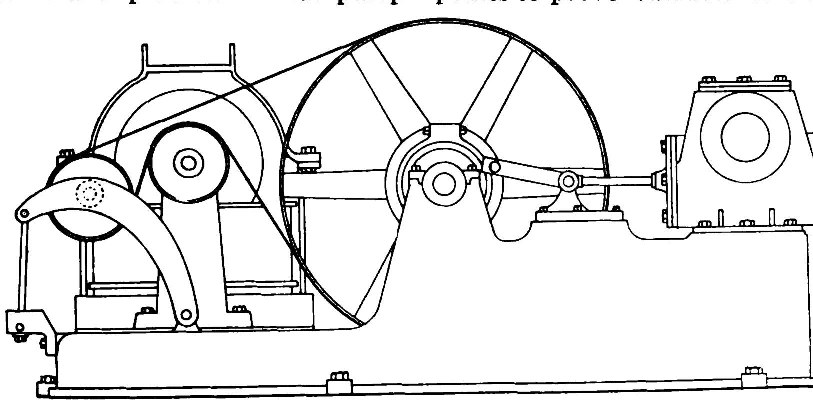

Fig. 9.

driven by a motor, and the whole machine is fitted to a small car. No other form of power transmission will bear comparison with electricity for this service. It is designed for any kind of construction work in which water collects as the job progresses. As the machine is moved farther away from the generator supplying the current, it is only necessary to lengthen the wire circuit, and this is easily done.

If used in mining operations it will be

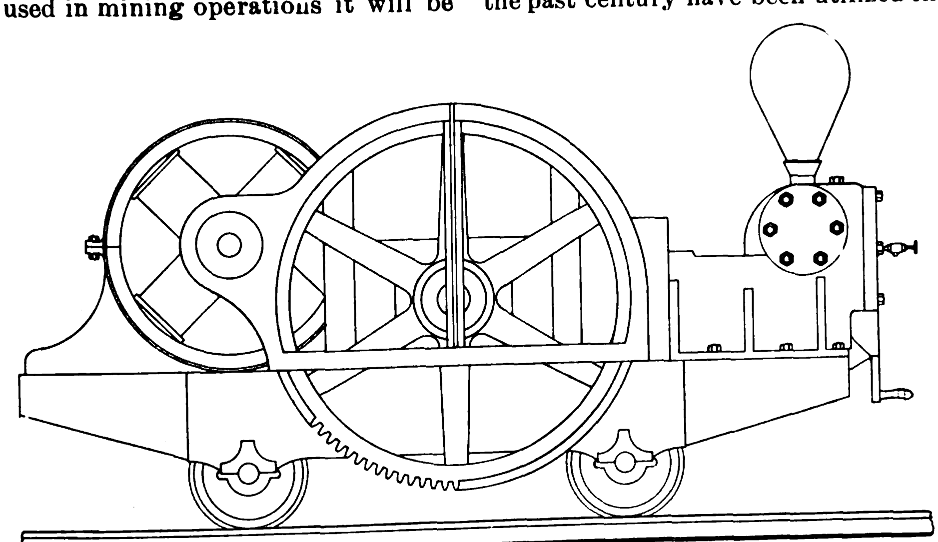

Fig. 10.

subjected to moisture, therefore it is well to prohibit the use of wood in its construction, which will swell and shrink thus destroying the alignment of parts. When constructed entirely of metal it proves satisfactory. The illustration shows a hand hole cover that affords access to the suction and discharge valves.

The foregoing description includes pumps used for a great variety of service, thus showing the wide application of electric transmission of power to this important branch of engineering. Due consideration of the matter cannot fail to show that great improvements have been made along this line, resulting in economical and convenient service in all departments. These articles do not cover the whole field to which electricity can be applied, but they do present enough points to prove valuable to the progressive engineer, and should be appreciated accordingly.

THE TELEGRAPH, TELEPHONE AND CABLE IN WAR.*

BY MAJOR SAMUEL REBER, U. S. A.

"War," says Von Moltke, "is the only science that lays under tribute all the other sciences." The great discoveries and advances in science made during the past century have been utilized in the art of war, and none, with the possible exception of steam, has produced a greater change in the application of its principles than the use of electrical means of communication. The saving of time, and subsequently money, by the use of the telegraph, the telephone and the cable in the affairs of daily life has been beyond calculation. The use of electrical means of communication is now absolately necessary to success in war, not only in the grand strategical combinations of a campaign, but also in the varying tactical situations on the field of battle.

*Paper presented before Section G, Electric Communication, at the International Electrical Congress held at St. Louis, Mo., September 12-17, 1904.

The element of time is one of the dominating factors in modern warfare, involving enormous expense incident to the equipment, maintenance, supply and movement of large fleets and armies. The longer the duration of a war, the greater the strain on the physical and financial resources of the nations involved. The ultimate result of a war may depend on the financial capacity of a nation to pay, feed and supply a victorious army. War disturbs not only the normal internal conditions of belligerent nations, unsettles and frequently paralyzes their trade, industrial and agricultural prosperity, but also produces a far-reaching result on the commerce of the world.

Nations are now so intimately connected by business and fiscal ties that the effects of a war are quickly felt in the markets of the world. Although business may be stimulated for a while by a war, the ultimate effect must be one of depression. The exhaustion of the resources of one of the family of nations, caused by a protracted war, is felt to a greater or less degree by all the others. Anything which tends to shorten the duration and limit the sphere of a war is a decided gain, not only to the belligerents involved, but to the world at large. Electricity with its space and time-annihilating properties has proved an ideal agent in shortening the duration of wars.

Napoleon in one of his maxims of war has said: "Le secret de la guerre est dans le secret des communications." It is absolutely necessary for the commander of an army to have rapid and positive means of communication for the transmission of orders, instructions and information from his extreme outposts in contact with the enemy back to his base in the rear of his army, and with all independent commands engaged in the theater of operations.

The development of the use of the telegraph, telephone and cable in war has been along lines similar to those of commercial practice. The engineering principles are the same, but the operative conditions are, of necessity, more exacting and difficult. Efficiency and certainty of operation under all conditions are the fundamental principles governing design. Cost of installation and economy of operation are of less importance than absolute continuity of service. It is not to be understood, however, that due regard should not be paid to cost of installation

and maintenance, but commercial methods fail under the stress of war conditions. A large number of ingenious methods and apparatus have failed on account of delicacy of operation of complication of design. Any apparatus that cannot stand lack of attention and skilled supervision, exposure to weather, rough handling in transportation, and the effect of the blast of heavy guns, cannot be relied on at the critical moment of its use in actual battle. Portability, simplicity and mechanical strength are essential requisites of all the apparatus used in the service of field communication. The demands of a fortress system of communication are not as exacting, while the installation and operation of military cables follows the commercial practice of the nations using them.

It is impossible in the scope of a single paper to give the characteristic features of the systems and apparatus employed by the various nations for military purposes, or the organizations of their special technical troops. With the exception of the United States, all the great military powers in the world control the service of electrical communication in time of peace as part of their civil establishment. Experience has proved that in time of war and especially in the field of active operations, this service must be part of the military establishment. All the great nations have special technically trained troops to operate their military systems. The operation of a system by joint civil and military control has proved a failure in the past, and the experiment will probably never be repeated.

The service of communication is, in general, separated into field and fortress work. The fortress system consists of the permanent lines, usually underground, connecting the various works in the line of circumvallation around fortified positions, and in seacoast works, the system of fire control and direction for the laying and training of the heavy batteries, rapid-fire guns protecting the mine fields, and the searchlights. The details of such systems are zealously preserved as governmental secrets for obvious military reasons. For armies operating in the field a complete chain of communication should exist from the outposts in touch with the enemy back to the capital of the nation, or the main base of operations, which is connected to the seat of government by permanent lines. In case of over-sea operations the base is connected by cable.

Depending on the construction used, the chain of communication is usually divided into three parts—permanent, semi-permanent and temporary, or flying lines. Permanent lines are usually those existing in the country or are built after the army has advanced. They are ordinarily outside of the zone of active operations, their construction following the usual engineering methods. When taken possession of and operated by the army the methods used are those of established commercial practice. Semi-permanent lines are used to connect the principle bases or depots of supplies on the edge of the zone of operations with the field bases within it, and the general headquarters. Field or flying lines are used in the zone of active operations and connect the general headquarters with all the principal subdivisions, even to the extreme outposts. In this service expedients of rapid construction of every nature are employed, and the telephone is fully utilized. It is possible to construct a line, using lances of ash or bamboo to support the wire, at the rate of from one to three miles an hour, depending on the character of the ground. By the use of light field cable and bare wire a detached cavalry column, or even a reconnoitering party, can be connected during its movement with the main body. At night each brigade and division headquarters can be connected by a field telephone system with the corps headquarters and the supply points, while the extreme outposts can instantly report any movements on the front. On the field of battle the commanding general can be connected telephonically with his corps commanders, and they in turn with their division and brigade commanders.

Major Von Etzel, of the Prussian Army, first suggested in 1839 to the War Department the possibility of employing the electrical telegraph, but it was not until 1844 that a board of officers was convened to consider this subject, and not for several years subsequent to that date was the necessary material obtained and a line built. There is no record of the result of this experiment.

In 1853, during the manœuvres of the Austrian Army at Olmutz, a movable telegraph line was constructed by stationing men at intervals to hold light lances to support the wire. Naturally the result was not considered successful.

The first practical application of the telegraph was during the siege of Sevastopol by the allied armies in 1855, where the searchlight was also first tried, the current for the arc being supplied by primary batteries. The dynamo was not used in searchlight work until the siege of Paris in 1871, where it was employed by the Germans, the French using primary batteries for the arc. During the siege of Sevastopol the lines were of permanent character and were not used for tactical purposes.

From 1854 to 1856 the Prussians again took up the telegraph for war purposes, but limited its scope to permanent lines. They did not contemplate its use in following the movement of troops, or on the field of battle, where it was first used by the federal forces at the battle of Fredericksburg in 1863.

During the great Indian mutiny, field telegraph lines were constructed connecting the column in the field with the seat of government in Calcutta. Uninsulated iron wire circuits suspended from trees, bamboo lances or even laid on the ground, were worked for a distance of 100 miles, although in the rainy season communication was frequently entirely interrupted.

In 1857, during the French operations in Algiers, the telegraph line was operated by civilians, the wire being suspended from trees. During the same year a school of instruction for military telegraphers was established by the English at Chatham.

Spain in 1859 organized and maintained in the Morocco war the first properly equipped and efficiently manned field telegraph train, using insulated wire coiled on reels and arranged for pack transportation, the instruments employed being Morse printing registers.

During the Franco-Austrian war in 1859 in Italy, the civilian employes of the State telegraph service operated the military system, which was maintained by peasant labor requisitioned from the inhabitants living in the zone of operations. This method of operation proved decidedly unsatisfactory, and the necessity for a military personnel and improved material was first recognized. During this campaign we find the first example of communication with the home government from the field of operations by telegraph, and the transmission of orders from the commanding general to both the front and flanks of the French Army.

The Italian Army in 1861 gave the first example of the value of continuous communication between parallel moving columns separated by a mountain range. Two army corps starting from different points marched to concentrate at Ancona, and although separated by the Appennine Mountains, were in constant communication with each other by lines that were built by and kept pace with the troops. Copper wire suspended by insulators on light poles were used. In front of Ancona the fleet, the front and flanks of the army, and the general headquarters

were connected together by a system of field telegraph and semaphores.

In the Civil War in the United States in 1861-65, the telegraph was considered indispensable, and was employed on a greater scale than ever before attempted or since reached. The results obtained awakened anew the interest of the great military powers in the development and equipment of their field organizations. For a while in the beginning of the war magneto instruments were employed but they were soon replaced by Morse sounders. Over 15,000 miles of line—land, submarine and field—were constructed. For the first time in the history of war the telegraph was used on the field of battle in the several encounters in the peninsular campaign and at Fredericksburg. General Grant, from his headquarters on the Rappahannock and at City Point, controlled and directed the movements of over 600,000 men in 18 separate armies manœuvring in a theater of operations that contained 800,000 square miles of territory.

It has been said that strategy is a fixed science and that wars during all ages have been conducted on the same strategical principles. The factors in the problems of strategy have been greatly influenced by improved methods of communication, and while the abstract principles have remained the same, the means of employing them have been greatly improved. Strategical combinations which were impossible at the beginning of the nineteenth century are now of frequent occurrence. Sherman's march to the sea compared with Napoleon's campaign of 1812 exemplifies this change. Napoleon early in 1812 made up his mind to invade Russia, but owing to the poor means of communication was unable to concentrate a force of 500,000 men and enter Russia from Poland until the last part of June. After 84 days and a very costly battle he entered Moscow. The country having been laid waste, the Russians retreated to St. Petersburg after having burnt Moscow, and a severe winter coming on, he retreated, losing 450,000 men. His downfall dates from this disastrous campaign. In 1864 Sherman began his advance into Georgia with 100,000 men in the early part of May. After continuous fighting for three months he entered Atlanta. His enemy had not been destroyed but fell back and began very active operations against his communications. He immediately communicated with the commanding general, some 1,500 miles away by wire, and arranged with him to march to the sea where supplies should be provided. Having reached the sea, he proceeded northward against the line of retreat of the main army of the enemy in Virginia. After having made a march of about 1,000 miles through the enemy's country, he materially aided in the final destruction of the Southern armies. These are the two longest marches in the campaigns of recent time, the one disastrous, the other highly successful. The failure in the one case was due to the lack of communications, the success of the other to their existence and utilization. "What was false strategy—because impossible—in 1812 was good strategy in 1864."

In the five years' war between Brazil and Paraguay in 1864-69, the telegraph was of great value not only in connecting the permanent works, but also detachments from the main armies and outposts. It was successfully used at the seige of Humaita.

During the six weeks' war in Bohemia the telegraph was only utilized to a limited extent owing to the contracted front of the theater of operations and the undeveloped stage of apparatus and material. No lines constructed were of greater length than 10 miles, as the permanent telegraph systems of the country could always be reached within that distance. Light field cables of the Siemens type were first used in this campaign, during which the headquarters of the three Prussian armies were connected by wire with the general headquarters of the King and the capital at Berlin. The working of the organization was not very satisfactory for strategical purposes. The personnel and material were unsuited for tactical use.

(To be continued.)

TECHNICAL EDUCATION—THE PERSONALITY OF THE PROFESSOR.*

BY A UNIVERSITY LECTURER.

One of the best definitions of a complete and generous education is that it is one which fits a man to perform justly, skillfully and magnanimously, all his duties, both private and public. In modern education there seems to be a twofold danger; we may be allured by a wide but shallow culture, or we may fall into the opposite extreme of exaggerated specialization.

It would be impossible to compare our present complex system of education with that of the ancient Greeks and Romans, but there is one great axiom upon which they built their educational structure, and which we in the modern days are perhaps rather prone to neglect. They saw, both Greek and Roman, although they acted somewhat differently upon the conviction, that character must be moulded by personal influence, and in the early systems of education of both countries we find this personal influence active. Then, as now, the way of knowledge was narrow and rough and steep; yet in those days it was not long. Then, as now, a great undiscovered country lay beyond it. The knowledge of nature, which has given later generations of men so marvelous a mastery over her resources, had not in those distant days been attained, nor yet even dreamed of. There was less hurry in education; nor was it deemed necessary to test the pupil's proficiency in his work or his qualifications for some post or office by constant examination.

More than anything these ancients believed in oral instruction. "Books are a mighty bloodless substitute for life," writes R. L. Stevenson. Many a promising engineering student fails to find the encouragement he needs, the inspiration of the living example of a worker between the bloodless covers of a text-book. We have our printed editions where they depended upon personal instruction; we rely upon the student's powers of memory where they depended upon the master's power of inparting knowledge. We are beginning to hazily realize that sympathy between master and student is essential; the ancient writers on education give proof of the quickest insight into the connection between character and learning.

The most optimistic among us are at times saddened at the present state of chaos in education. The reason is not hard to seek; there is a great absence of definite purpose and aim; of those who are educated and being educated few realize why they are gathered together. Knowledge has been increased and the subject matter of instruction in the one branch of instruction—electro-technics—has multiplied and is multiplying with appalling rapidity. A choice in our work must be made, but who will guide us? We do not wish to become narrowed, but we cannot bear to be left behind in the race for knowledge. We still hear the voices lifted up in praise and defence of a classical education, which, it is urged, is invaluable in disciplining the mind and forming a cultured taste. We hear the cry of the greatest men of the last decade: "Study science," they say, "for the hopes of mankind lie in the increase of that knowledge of nature which alone is power." We have an indefinable long

*From the "Electrical Review," London.

ing, even the most selfish of us, to do something for our fellows, and how greatly we desire to follow this second, and, to us, more practical voice. And the third voice—small, but at times piercing—the voice of poverty, which tells us that it would be best to study whatever subject will bring us the greatest freedom from money cares. We find that life has become more complex and the struggle grows daily harder and the strugglers more numerous. Thus are we tempted to feel at enmity with a world which will pay us only for that portion of our personality which is marketable.

The decree has gone out that the great and small are to be examined, and we all bow the knee to the examination idol. Our professors do not awaken in their students a love of knowledge for its own sake; they do not even seek to make the studies interesting and attractive, for they tell us that the examination is the spur to exertion; they hold up the fetish of marks, honors and emoluments. More and more the professor delegates his duties to his underpaid assistants—they hear the voice of poverty, and in order to live they must do other things than teach. Less and less of his instructors does the student see, and gradually he obtains, like Shakespeare's knight, "a mint of phases in his brain;" odd clippings from partially understood lectures and semi-digested text books. A recent book on education, has on the cover "A view of the interior of a library;" so do we associate education with books. There is a great sacrifice of observation to book learning. Our students must be educated individually; we must develop to the utmost the possibilities of every single man; not pass a number of units through a certain process in the hopes that they may retain a superficial polish which will last through life. The friction of the world quickly lays bare the baser metal. If the number of students increases so rapidly that it is impossible for the one or two professors to see to them individually, you must increase the number of your professors. If the lecturers are compelled, for the sake of promotion, to do research work, you must so lighten their teaching duties that it is not done in the time during which students should be instructed in the lecture rooms or laboratories. Do not let the individual student suffer, for in each one you have the possibilities of a great man, in every one the certainty that his future can be affected by the amount of work he does under the immediate supervision and advice of an instructor. I think that it is Prof. Perry who tells us of the stimulus he obtained through working under great masters. I once went into the experimental laboratory of Sir Oliver Lodge, and I watched that great man testing a new invention. Only for 20 minutes did my lesson last; perhaps, in all, a dozen words were spoken. But I carried home with me that night an impression which will last as long as memory; the idea of the indefinable grandeur of a life devoted to the seeking out of things new and useful for the progress of the age. How I almost envied the skilled mechanic who connected up the wires, and who, too, had caught the infection of the spirit of discovery. How I longed that I might be brave enough to thank this silent worker, the genius who had a few days previously enthralled an audience of electrical engineers at an Institution meeting, and who treated me (a subaltern in the great army of which he was general) as a fellow worker and with sympathy. How greatly did I desire to ask that I might work and watch in that laboratory, even though my duties were never more important than connecting wires. There before me was the lecture of a life-time, but there were none others but the skilled mechanic and myself to profit by it.

It is sometimes easy to see difficulties, it is always hard to overcome them. But we want some system in our university education, whereby the student shall see more of and come more into personal contact with the professors.

We want to teach our sudents at universities something more than what is sufficient to get them through their examinations. I saw the greatly lamented and respected late secretary to the Institution of Electrical Engineers in the metallurgical laboratory with his students. At that time he was known to a much smaller circle than latterly, but what an influence he had with his men! There is an under-manager of a big motor works in the Midlands who told me that Mr. McMillan was the man whom he had to thank for teaching him perseverance. He will remember that word when the metallurgical formulæ have become obsolete, and his own experience has swamped his early knowledge. We lecturers, perhaps, are not held so much in awe by the students, for we seem to know them better than the professors. And we often accidentally overhear our budding engineers tell each other that they wished that they saw the professor more often in the laboratories. Yes, it will be a bright day for university education when the councils create more professorships and lectureships, so that the individual student may receive more direct instruction.

THE CARBON CELL.*

BY PROF. DR. F. HABER AND DR. L. BRUNER.

Among the various attempts to construct galvanic cells in which an electric current is produced by the consumption of carbon there is none that has been of greater interest than the experiment of Jacques, who proposed the cell consisting of the following:

Carbon—fused sodium hydrate—iron.

This cell has been the subject of experiments by numerous investigators, especially Mr. C. J. Reed in America and Messrs. Liebenow and Strasser in Germany. Experiments which we ourselves have conducted show that the true nature of this cell is different from what it was supposed to be.

Let us consider first the behavior of each of the electrodes separately. The iron electrode in the fused sodium hydrate is gradually covered with a protecting layer or skin of the oxide. As soon as this has been produced the iron is no longer attacked, while previously it went into solution in the fused salt as iron oxide with the development of hydrogen gas. This protecting skin can be produced rapidly if the iron is dipped for a short time into fused salt-peter, and subsequently carefully freed from the salt-peter by means of water. The iron thus coated with this protecting skin is called "passive" because the fused sodium hydrate produces no further changes on it.

The passive iron represents an oxygen electrode on which the atmosphere oxygen acts similarly, but better, than on a platinized platinum electrode dipped into an aqueous conducting solution. This action of the oxygen is brought about by the presence of sodium manganate, which is always present in small quantities in fused commercial sodium hydrate, and especially when in contact with iron, and its presence can easily be proved chemically. Quite pure sodium hydrate, when fused and in contact with commercial iron, will contain some manganese, because a small quantity of manganese forms a normal part of commercial iron and gets into the fused salt when the iron is attacked by the sodium hydrate previously to the production of the passive state. By means of the atmospheric air it becomes a manganate.

The passive iron, as an unattackable electrode, can be replaced by another indifferent electrode, as, for instance, by platinum, and without changing the force

*Paper presented before Section C of the International Electrical Congress, held at St. Louis, Mo., September 12-17, 1904.

and the method of action of the electrode in fused sodium hydrate containing manganese.

If platinum is placed into pure sodium hydrate the potential at the electrode is uncertain. A very small quantity of a manganate suffices to give rise to a different value, which does not change during a further addition of a manganate up to 2 per cent. of the weight of the sodium hydrate.

If the added sodium manganate is reduced by forcing in some hydrogen or carbon monoxide, or by the addition of sodium oxalate or sodium formate, quite an extraordinary change will take place in the potential. But by forcing in some atmospheric oxygen the original value of the potential is again reached.

In these experiments the potential of the platinum electrode is thus brought about by the absorption of oxygen. If a permanganate is added to fused sodium hydrate, oxygen will be evolved and the potential will, contrary to the other case, be brought about by the evolution of oxygen. These potentials are measured most simply by letting the syphon of a decinormal-electrode terminate in a small vessel containing concentrated sodium hydrate, which is in electric contact with the fused salt which is to be tested, by means of a rod of solid sodium hydrate. In all the measurements the fused salt was in a large silver crucible. The observed values are collected in the following table for different temperatures. The temperature was measured thermo-electrically:

Centigrade degrees	312	336	360	388	412	472	532
Potential in volts against decinormal-electrode...	−0.265	9.294	−0.314	- 0.333	0.353	0.431	−0.472

These values were measured with a platinum electrode, a small quantity of the manganate being added to the sodium hydrate. Numerous tests showed that absolutely equal values of the potential are obtained with an electrode of passive iron. An earlier opinion from other sources, namely, that the presence of certain steps in the oxidation of the iron in the fused salt is of importance in the behavior of this electrode, is not proved to be correct.

Let us now consider the carbon electrode.

When a carbon electrode is tested in the way above described for iron and platinum, all possible values can be observed between —0.6 and —1.5 volts toward the decinormal-electrode. With closer study one finds that the potential approaches the value —1.5 volts more and more, the more rapidly the carbon is attacked in the fused sodium hydrate with the evolution of gas. This attack is less the denser and the more graphitic the carbon is. Electrodes which are treated by the process of the International Acheson Graphite Company, therefore, remain very far from this value, −1.5 volts. Ordinary arc-light carbons on the other hand can generally be made to produce a free-gas revolution when the fused salt in which it is dipped is heated to above 500 deg. C. They then reach quite or nearly the value —1.5 volts and remain at this value when the fused salt in which they are dipped is cooled to the point of solidification. But as the accompanying evolution of gas gradually diminished at a lower temperature (about 350 degrees), the potential will simultaneously change; it will diminish to the value —1.3 or —1.2 volts, etc.

The gas which the carbon electrode evolves in the hot fused sodium hydrate is hydrogen gas.

If, instead of the carbon electrode, a platinum tube is dipped into the fused sodium hydrate and pure hydrogen gas is led through it into the liquid, one obtains with a strong current of gas the potential −1.5 volts, and this will be the case at all temperatures between 500 degrees and the point of solidification of the fused salt. If the current of hydrogen gas is made weaker, the value —1.5 volts will not be reached; the figures will be smaller. The potential of the carbon in the fused sodium hydrate is, according to this, not determined directly by the carbon, but by the hydrogen which the action of the carbon on the fused salts sets free.

The temperature produces no effect on the potential within the given wide range but the rapidity of the evolution of the hydrogen is of great importance.

Before we recognized this connection between the two we had held a different conception concerning the process at the carbon electrode. We supposed that a formic acid salt or an oxalic acid salt, or carbon monoxide were produced, and that these materials determined the potential at the carbon electrode. We, therefore, tested the action which an addition of the two named salts or of the introduction of carbon monoxide had on the fused salt, and on the behavior of the platinum electrode which is dipped into the fused salt. We found by chemical investigations that former statements in the literature were confirmed, according to which oxalates and formates in an excess of fused sodium hydrate, pass over freely into carbonate and hydrogen gas. Formates may be assumed to be a combination of carbon monoxide with sodium hydrate, and oxalates may be assumed to be a combination of carbon monoxide with an alkali carbonate. We assumed, therefore, that carbon monoxide with sodium hydrate could also produce hydrogen and sodium carbonate. We found this to be definitely proved to be a fact, when we led carbon monoxide through a silver spiral heated to 350 degrees, in which there was fused sodium hydrate. The following reaction is thereby obtained with great ease:

$$Co + 2\,NaOH = CO_3Na_2 + H_2.$$

If it can be proved by means of thermodynamics that the oxalate, the formate and carbon monoxide, when they act as such on the electrode, should manifest their potentials, which exceed — 1.5 volts. Such potentials, however, were never observed. On the other hand it was found that all three materials as such were inactive at the electrode, and that it was only the hydrogen evolved by them which charged them and brought their potential more or less closer to the value —1.5 volts, according to the rapidity of the release of the gas. According to these principles we are in a position to say that the so-called Jacques carbon cell is a hydrogen-oxygen chain, in which the oxygen of the air, by the intermediate action of the manganates at the iron electrode, acts with the hydrogen released by the carbon from the fused salt at the other electrode. The power of this element depends on the consistency of the carbon. If the latter is loose and capable of producing hydrogen gas evolution, one obtains those values which are found when one deducts —1.5 volts from the above-mentioned values for the oxygen electrode. As for instance, (−0.265 + 1.5), that is, + 1.24 volts at 312 degs. C, and (— 0.472 + 1.5), that is, + 1.03 volts at 532 degs. C.

Thermo-electric phenomena take no part in the production of these electromotive actions. For these forces do not depend in the least on the materials iron and carbon, but only on the gases oxygen and hydrogen, and the same platinum tube shows alternately the force of the iron and the carbon electrode, if at constant temperature we pass through it oxygen and hydrogen respectively.

The element under discussion is without importance from the practical standpoint, because during its action the valuable carbon electrode and the equally expensive sodium hydrate are changed into cheap soda, only to obtain a little hydrogen which acts electromotively.

From the theoretical standpoint such a hydrogen-oxygen chain offers very much of importance. It is differentiated from the old well-known Grove hydrogen-oxygen chain, in that it is not liquid water, but a solution of water in fused sodium hydrate which is produced by its action.

The relation which Helmholtz has proved for the connection between the electromotive force of reversible galvanic chains and the reaction heat of the process which produces the current enables us to calculate the heat of reaction in the present case. This is shown to be 81,650 gram calories per gram molecule of water produced. But as the formation of a gram molecule of water vapor at the range of temperatures of the experiment sets free approximately 58,650 gram calories, it follows that the evolution of heat which accompanies the absorption of a gram molecule of water vapor by a very large quantity of fused sodium hydrate has a value of approximately 23,000 gram calories. This high value arises from the fact that fused sodium hydrate holds the last traces of water with unusual tenacity, as has already been shown by others.

One can carry out the theoretical conception on the basis of the Helmholtz relation above given in still another way. One can, for instance, suppose at the start that an equilibrium exists between a fused salt containing water, and the vapor pressure of the water above it. In this way one arrives at the conception that the action of our chain depends on the change of the atmospheric oxygen, which has a pressure of 0.2 atmosphere, and the hydrogen which has an atmospheric pressure, into water vapor of a pressure corresponding to the state of equilibrium above the water containing the fused salt.

When we integrate the above-mentioned differential equation of Helmholtz, and for comparison consider the known values of the force of the Grove gas chain, we can calculate the vapor pressure above the fused sodium hydrate at different temperatures. The carrying out of these theoretical calculations requires a more extended representation of the case, and this departs too far from the intention of this discussion to be embodied here. One can find it in an extended treatment of the subject which will appear in the German language in the "Zeitschrift fur Elektrochemie. The result of the calculation is that the vapor pressure above fused sodium hydrate at 300 degrees is extremely small and increases with increasing temperature. The fused mass is, therefore, especially hygroscopic near its point of solidification, and the force of the hydrogen-oxygen chain at this temperature is the highest. That the force of the Jacques carbon cell increases with the temperature is not in contradiction with this, but is explained according to our former statement by the fact that the evolution of hydrogen by the carbon increases in rapidity very quickly with increasing temperature.

Electric Power for Oil Wells.

Mr. M. L. Gaster, says the "Electrical Engineer," London, has tabulated some facts regarding the use of electricity in connection with petroleum production. The demand for petroleum greatly exceeds the present production. The substitution of oil for coal, in order to be advantageous, needs a better regulation of the methods of producing it, and also of the price. In this connection the use of electric motors is a question of great interest.

Mr. Gaster considers that the employment of electricity, which is generated in a large central station, to operate motors for petroleum wells is justified by the area covered by the wells, as well as by the fact of the danger from fire caused by the steam engines, which operate the drills and pumps. A central station system also has the advantage of being able to cope with the variations of load at the different wells. Electric motors were first used for drilling wells some five or six years ago in Roumania. The plant was provided with a set of motor driven pumps. A central station was erected at a distance of 1½ miles. The motors are of the three-phase type, operating at 300 volts. The total capacity of the station is 200 kw.

Later, the Lahmeyer Company erected a large station for working the wells at Campana and at Bushtenari. The first cost of the plant was £500 per well and the running expenses £8 per horse power year. In Russia, which is the greatest petroleum-producing country, the conditions are less favorable to the use of electric power, owing to the fact that the oil consumed to furnish the power for the wells is not subject to any tax, and therefore a very cheap supply of energy can be had. It is to be noted, however, that a large number of electric plants have lately been installed in that country.

Tesla Currents.

In a paper read before the Bunsen Society at Bonn, Prof. Nernst discusses the fact that it is possible to pass through the body without the least discomfort Tesla currents of a strength which at a much lower frequency would certainly cause death. The explanation hitherto offered has been that the current passed by the surface of the body only. According to Prof. Nernst, however, the explanation is to be found elsewhere; and he maintains that the solution of the problem lies in the fact that the current never lasts sufficiently long in one direction to alter the concentration of the contents of the cell. He finds that changes in concentration vary directly with the strength of the current, and inversely as the square root of the frequency. He has confirmed this hypothesis by an experiment on a frog submitted to a current, the frequency of which could be varied between 100 and 200 cycles per second.

PREDICTS COLLISIONS IN THE SUBWAY.

Editor ELECTRICITY.

SIR: In your issue of October 19, first page, is found an editorial on "Guarding Against Collisions in the Subway," and you state that officials say "that late experiments have proved that there can never be a collision on the underground road as long as the present block signal system is maintained."

I beg to take issue with such an extraordinary statement and to prophesy at this time that there will be at least one or more collisions in the subway within 18 months from the date of its opening, and by reason of the failure of some of the signals. It is a matter of common knowledge that compressed-air controlled systems, such as are to be used in the subway, are more dependent on three sources of energy, namely, air under pressure, gravity and electricity. It is well known to experts in such matters and to others who have taken occasion to investigate the question, that such signals often fail to act and that in fact the signal engineers of the prominent roads throughout the country, keep a daily record of the failures thereof. This failure is in most instances probably due to the sticking or adhesion of the valves in the controlling apparatus, which valves are operated in one direction by electro-magnets and in the reverse direction by springs.

No human being can devise a seat-valve like that used in this apparatus which will not be liable to stick; nor can any human being devise a system of air-controlled apparatus in which moisture due to condensation will not accumulate therein, and oftentimes so rapidly that unless it be removed immediately the apparatus will fail to work, and in winter time such condensed moisture will and does freeze.

The entire system of safety signals

found in the subway is of a very complicated nature and the certainty of operation is made dependent upon the certainty of the sliding seated air-controlling valves to be moved by springs when released by the operating magnets.

It is a well-known fact that air-controlled signals often fail to act for the reasons above pointed out; in fact the writer has noted as many as five failures from the rear-end of a train in coming from Washington to New York, and other persons have called his attention to like failures, it being now well understood that railway engineers running under the control of such a system frequently run by the signals and depend largely upon their mental faculties to avoid accidents.

It is true there has been, so far as I am aware, no material accident in the subway system of Boston, which is operated by air-controlled signals, but the proposition which is offered in the subway in this city is vastly more complicated and necessitates the running of trains at greater speeds and higher frequency than is done in Boston.

The attention of the management of the subway and of the elevated road has heretofore been directed to the fact that there is a system of signals controlled wholly by electricity and gravity, in which the operation of the signals is absolutely certain by reason of the elimination of the most important agency, which is liable to fail in its operation in the system used in the subway, namely, the compressed air.

The consulting engineers, however, who installed the subway system were closely related in a business way to the owners and operators of the signaling system which has been adopted, and for this reason no doubt other systems have been ignored.

It appears to the writer that public safety demands that the signal engineers of various railways utilizing alleged safety systems should make known by publication the failure of signals to operate, thus showing how inefficient and utterly worthless such apparatus often is, or that legislation be had requiring yearly reports to the railway commissioners of the failure of signals; the cause thereof, and accidents due to such failures, would be most wholesome and would ultimately show up the worthlessness of many alleged automatic safety devices which are now foisted upon the railway companies by corporations whose influence is such as to oftentimes prejudice the adoption of reliable apparatus.

Yours truly,

C. J. KINTNER.

New York, Oct. 22, 1904.

New York Electrical Society.

The 245th meeting of the Society will be held at the American Institute, 19 West 44th street this (Wednesday) evening, October 26, at 8 o'clock. Prof. A. S. McAllister of Cornell University will lecture on "The Alternating Current Railway Motor."

Proposals Invited.

The municipality of Chivilcoy, Province of Buenos Ayres, is open for proposals to build an electric lighting plant for said town.

The municipality of Philippopolis, Bulgaria, will receive proposals for erecting an electric plant for lighting the city and furnishing power for running a tramway line.

The Electrical Owtschar and Kablar in Tschatschak, Kingdom of Servia, is open for bids to furnish turbines and generators, with requisite hydro-electric material and cables for transmitting power to a distance of about 44 miles.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCT. 18, 1904.

Electric Railways and Appliances.

772,348. Transmission-Gear. Arthur J. Farnsworth, New York City, assignor to the Railway Electrical Improvement Company, same place. Filed Feb. 5, 1903.

772,349. Power-Transmission Device. Arthur J. Farnsworth, New York City, assignor to the Railway Electrical Improvement Company. Filed Feb. 16, 1903.

772,456. Electrical Conductor for Electric Railways. Theophilus P. Chandler, Philadelphia, Pa. Filed April 18, 1904.

772,547. Trolley-Switch for Block-Signal Systems. Joseph Weatherby, Jr., New Cumberland, Pa., assignor to the Weatherby Electric & Manufacturing Company, New Cumberland, Pa. Filed Dec. 7, 1903.

772,548. Signal Mechanism for Block-Signal Systems. Joseph Weatherby, Jr., New Cumberland, Pa., assignor to the Weatherby Electric & Manufacturing Company. Filed Dec. 10, 1903.

772,638. Trolley-Head for Electric Tram-Cars. Wilhelm Willenbucher, Manchester, Eng. Filed Jan. 7, 1904.

772,679. Electric-Railway System. Elmer A. Sperry, Cleveland, O., assignor, by mesne assignments, to the Morgan Electric Machine Company. Filed Nov. 12, 1902.

772,730. Electric-Railway System. Edmund C. Morgan, Chicago, Ill., assignor, by mesne assignments, to the Morgan Electric Machine Company. Filed Aug. 27, 1902.

772,732. Switching System for Combined Third and Traction Rails for Electric Railways. Edmund C. Morgan and John H. Morgan, Chicago, Ill., assignors to the Morgan Electric Machine Company. Filed Aug. 8, 1904.

772,735. Throw-Rail for Combined Third and Traction Rail Switching Systems. John H. Morgan, Chicago, Ill. Filed April 16, 1904.

772,838. Life-Guard for Tram-Cars or Other Electrically-Propelled Vehicles. William Simm, Portico, Eng. Filed Jan. 12, 1903.

772,851. Car-Fender. William T. Watson, Newark, N.J. Filed Dec. 28, 1903.

Electric Lights and Appliances.

772,877. Electric Lamp. George F. Fischer, New York City, assignor to Thomas J. Bull and Henry D. Schaad, same place. Filed July 9, 1902.

772,908. Flashing Device for Incandescent Electric Lamps Cornell Ridderhof and Greyson E. Miles, Grand Rapids, Mich., assignors to the Wilmarth & Morman Company, same place. Filed Dec. 9, 1903.

Electrical Machinery and Apparatus.

772,391. Variable-Stroke Mechanism. Henry S. Baldwin, Lynn, Mass., assignor, by mesne assignments, to the General Electric Company. Filed July 5, 1902.

772,400. Electrical Machine. Ole S. Bragstad and Jens L. La Cour, Karlsruhe, Germany. Filed June 13, 1902.

772,419. Controlling Mechanism for Flash-Boiler Systems. Herman Lemp, Lynn, Mass., assignor, by mesne assignments, to the General Electric Company. Filed Oct. 2, 1902.

772,465. Alternating Current Motor. Waldo A. Layman, St. Louis, Mo. Filed March 9, 1903.

772,571. Electric Motor-Vehicle. Hiram P. Maxim, Harry M. Pope and Herbert W. Alden, Hartford, Conn., assignors, by mesne assignments, to the Morton Trust Company, trustee. Filed Sept. 24, 1897.

Telephones and Telephone Apparatus.

772,459. Counter for Registering Calls for Automatic Telephone-Exchanges. John Erickson, Chicago, Ill., assignor to the Strowger Automatic Telephone Exchange. Filed Nov. 15, 1902.

772,773. Combined Receiver and Transmitter Bracket for Telephones. Harry A. Barnes and Nelson E. Showacre, Baltimore, Md. Filed May 6, 1904.

772,782. Signaling Device for Telephone Systems. Henrik T. Cedergren, Stockholm, Sweden. Filed Jan. 28, 1902.

772,833. Telephone-Exchange System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company. Filed Oct. 21, 1899.

772,871. Telephone-Exchange Trunk-Circuit Apparatus. Charles A. Crapo, Denver, Col., assignor to the Western Electric Company. Filed Dec. 29, 1902.

772,896. Apparatus for Telephone-Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Dec. 26, 1899.

772,897. Busy-Signal for Telephone Trunk-Lines. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Jan. 14, 1901.

772,898. Trunk-Line for Telephone Exchanges. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Jan. 26, 1901.

772,899. Supervisory Signal for Telephone-Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Filed Feb. 12, 1902.

772,900. Telephone-Exchange System. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed Jan. 14, 1901.

Miscellaneous.

772,350. Electrical Conduit. Alfred Fellheimer, Chicago, Ill. Filed Oct. 19, 1901.

772,354. Electric Furnace. Henry Harmet, St. Etienne, France. Filed March 20, 1902.

772,396. Quadruplex Telegraphy. John C. Barclay, New York City. Filed Feb. 1, 1904.

772,415. Battery-Holder. Frank Jackson, Denver, Col. Filed March 4, 1904.

772,590-591-592. Induction-Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed July 12, 1904; July 18, 1904.

772,630. Method of Transforming Electrical Currents. Albert L. Parcelle, Boston, Mass. Filed April 10, 1903.

772,644. Fire-Alarm System. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, same place. Filed May 9, 1904.

772,666-667. Roentgen Tube and X-Ray Tube. Carl H. F. Muller, Hamburg, Germany. Filed Nov. 22, 1902; March 23, 1904.

772 772. Thermo-Electro Fire-Alarm. Herman Barditzky, Memphis, Tenn., assignor of one-half to Frank Sybilla, Chattanooga, Tenn. Filed May 14 1904.

772,872. Current-Saving and Spark-Reducing Device for Electromagnets. George H. Davis, Brooklyn, N. Y. Filed Dec. 8, 1900.

772,878. Magnetic Detector. Lee de Forest, New York City. Filed June 20, 1903.

772,879. Art of Duplex Wireless Telegraphy. Lee de Forest, New York City. Original application filed June 4, 1903. Divided and this application filed Sept. 21, 1903.

772,893. Attachment for Telegraph-Keys. Daniel A. Lawrence, Weldon, N. C. Filed Nov. 18, 1903.

Reissues.

12,273. Electric Circuit Closer and Breaker. Thomas H. McQuown, Biggsville, Ill. Original application filed Sept. 26, 1902. Patented Jan. 19, 1904, No. 749,743 Divided and application for reissue filed July 7, 1904.

12,274. Electrical Warp Stop-Motion for Looms. Frederic Kip, Montclair, N. J., assignor to the Kip-Armstrong Company. Filed Aug. 13, 1904.

THE TELEPHONE WORLD.

Keystone Telephone Company Sells Conduits.

The Philadelphia Electric Company has agreed to purchase from the Keystone Telephone Company the latter's conduits and franchises, said to be the most valuable of their kind ever granted by the city, for $2,500,000 cash. In turn, the Keystone Company agrees to use the conduits and pay therefor an annual rental of $125,000.

The deal ends the controversy between the factions represented upon the one hand by John M. Mack and his friends, and on the other hand by the Thomas Dolan-Joseph B. McCall syndicate of financiers.

A director of the Electric Company is quoted as follows, in reference to the financing of the deal:

"There seems to be no need of making a new assessment on the stock to finance the purchase of the Keystone Telephone conduits. We have $2,000,000 of the Philadelphia Electric 4s in the treasury, on which we could borrow, perhaps in the form of collateral trust notes, and also cash in hand remaining from the $1,250,000 paid in last June as the first installment on the present call, $1,250,000 more will be payable next December. There are none of the Pennsylvania Manufacturing 5s in the treasury, the $2,000,000 of the issue having been canceled.

"The Philadelphia Electric Company, as it receives $125,000 rental per annum from the Keystone Telephone Company, will be getting 5 per cent. on the cost of the conduit property, $2,500,000, and so if the Philadelphia Electric Company does borrow some money to help out financing, the investment will be paying for itself."

Ed. L. Barber, of the Telephone Construction Company of Barber and Brailey, says that work on the toll lines of the Independents in Kansas and Missouri is progressing rapidly, and that it will be possible in a few months to telephone from Indian Territory to Kansas City and Toledo. The line is now complete as far as Ottawa, Kan., and work is being pushed on the new lines to the south and west as fast as possible.

The Hazen, Ark., city council has granted a franchise to the Hazen Electric Light & Telephone Company, to put in a local long-distance exchange at once, and also to give the town electric lights in the near future. The company is composed of E. K. Hathaway, T. P. Young and Mrs. E. K. Hathaway.

The Millersburg, Orrville & Wooster Telephone Company at a recent meeting at the office in Millersburg, O., elected a full board of directors, who then selected the following officers for the coming year: President, George Adams, of Millersburg; vice-president, Frank L. Beam, of Mt. Vernon; secretary, B. C. Sill; treasurer, John E. Kock, both of Millersburg.

The net output of the American Telephone & Telegraph Company increased 21,984 instruments for the month of September, and 48,286 instruments for the fiscal year to September 30.

The Independent metallic telephone system has been established in Lumber City, Ga., with long-distance connections.

South Dakota Farmers Organize Telephone Company.

A number of farmers residing west of Letcher have organized what will be known as the Storla Telephone Company, and are rapidly completing the work of extending lines through the rural communities.

Four lines belonging to the company are being constructed with the Storla postoffice as the central point for all of them. It is proposed to extend the lines northwest to the town of Lane, and southeast and southwest to the farming communities in those directions.

One of the lines extends to Letcher, and brings the business men into direct communication with a large number of their farmer customers.

Additional Telephone Facilities.

The Gainesboro Telephone Company of Carrollton, Ga., has been engaged in constructing an additional circuit between its main office and Bremen, 12 miles north of Carrollton in Haralson County. Bremen is now reached through Villa Rica, and increased business in the territory expanded to the west and north of Bremen demanded additional facilities there. This company is aggressive in its policy of extending the service and now covers 17 counties in that section.

The war between the New York Telephone Company and the State Line Telephone Company for the Yonkers, N.Y., franchise, induced a reduction of rates all along the line in that city last week, by the New York Telephone Company, which now holds the franchise the other line wants. The rate from Yonkers to New York was reduced from 35 to 25 cents, city calls were made five instead of ten cents; other rates were reduced from five and ten cents.

Considerable success has attended the efforts of the promoters of the Cascade, Mont., County Rural Telephone Company in their work of disposing of stock of the company for the purpose of raising money to defray the cost of constructing the proposed telephone line through the farming community south of Great Falls, terminating in the vicinity of Black Butte. Great Falls has been canvassed by C. F. Stork, of Red Butte, and with the old subscriptions between $1,800 and $1,900 has been promised.

A network of rural telephone lines will have its center at Parker, S. D., as the result of the organization and incorporation of the Steninger Telephone Company, with a capital of $50,000. The company already controls about 85 miles of rural lines.

The Pioneer Telephone Company has begun work on a new telephone system in Muskogee, I. T. It will cost $50,000. This company owns the old system, which will be replaced. The Pioneer Company owns nearly all the toll lines in Indian Territory.

The Independent Telephone Company organized at Marshall, Mich., three years ago, has been sold to the Michigan Telephone Company, it is reported, by F. A. Stuart, the principal stockholder.

Colorado Cities Agitating Independent Movement.

Frank L. Bills, an Independent telephone company organizer, has lately been in Denver "just to look Colorado over," and there is much speculation rife as to what may happen.

Mr. Bills will visit Colorado Springs and several other Colorado cities which have been agitating the Independent movement. He has been instrumental in organizing more than 100 Independent telephone companies in the Middle Central States, and is now just completing new systems in Lincoln, Neb., and Sioux City, Ia.

"In the Central States the long enjoyed monopoly of the Bell Company has been seriously interfered with," said Mr. Bills, "Iowa alone has 1,500 Independent companies and these work together, leaving the Bell but little outside of the long-distance business."

The Diamond State Telephone Company of Delaware, which recently acquired control of all the telephone companies in Onancock, Va., is now busy putting up the improved local and long distance system. Communication was established with Baltimore the middle of this month.

Work has been commenced on a telephone system for the Cheyenne River Indian reservation lines to be run from the main agency near Forest City, S. D., to Cherry Creek, in the southwest corner of the reservation, and to White Horse Camp in the northwestern corner.

The Co-operative Telephone Company, of Detroit, Mich., has established direct copper connections with Toledo, O., having over 9,000 Independent telephones and other exchanges in Ohio and Indiana, with over 400,000 subscribers and low rates.

Preliminary steps have been taken at Keyser, Md., for the establishment of an Independent long distance telephone company. A line will be built between Philadelphia, Baltimore and Pittsburg. It will extend through Romney, W. Va.; Cumberland, Piedmont, Keyser, Oakland and Somerset.

The Interstate Telephone Company will add 75,000 'phones to the system in Clinton, Ill. giving that city a fine long-distance service.

The Badger Telephone Company is working on a line to connect Corliss with Delavan and Janesville, Wis.

Telephone Incorporations.

The Shiawassee & Genesee Mutual Telephone Company, Lennon, Mich. Capital stock, $10,000.

The Eastbrook Telephone Company, Ltd., Eastbrook, Me.—to construct telephone lines. Capital stock, $2,000. Officers: President, S. S. De Beck. Franklin, Mass.; treasurer, R. B. Laurie, Eastbrook.

The Acme Electric Telephone Company, Chicago, Ill.—to manufacture electrical appliances. Capital stock, $10,000. Incorporators: A. B. Schaftner, Harry Goodman and G. Kreis.

The Kansas Telephone Construction Company Kansas City, Mo. Capital stock, $75,000. Incorporators: James S. Brailey, Jr., Toledo, O.; Edward L. Barber, Wauseon, O.; O. C. Snyder, W. C. Polk and Hugh C. Ward.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Anadarko, Okla.—The Anadarko Ice Plant Company recently made a proposition to the city to establish an electric lighting and power plant.

Buford, Ga.—This city has held a special election to vote on the issuance of bonds to the amount of $20,000 for school buildings, electric lights and waterworks. The same was carried.

Camilla, Ga.—The special election held recently to vote on the matter of issuing $20,000 bonds for waterworks and an electric light plant was carried.

Chickasha, I. T.--L. Martin has the contract to erect the new electric lighting plant here.

Dallastown, Pa.—The people here have voted for an up-to-date lighting plant.

Divernon, Ill.—Bids will soon be advertised for the installation of an electric light plant to cost $5,000.

Fordsville, Ky.—The board of trustees has passed a resolution for the building of an electric light plant here.

Geneva, Neb.—This town is soon to have an electric lighting plant.

Granite, Ill.—The Granite City Gas, Light & Fuel Company has been incorporated with a capital of $200,000 to operate electric light plants. W. F. and H. F. Niedringhaus are interested.

Greensboro, Ga.—An election will be held here November 8 to vote on the proposition to install an electric light plant.

Guthrie, Okla.—The Guthrie, Fairview & Western Railway Company will build a modern electric lighting plant.

Harvard, Neb.—The city council has under consideration three propositions for an electric light plant. One on a petition signed by 100 or more property owners for voting bonds and city ownership, and two by private parties for a franchise and individual ownership.

Hoosick Falls, N. Y.—The Hoosick Falls Generating Company has been formed to operate electric plants. Its capital stock is $25,000 and directors, W. Z. Roberts, J. Beverly and others.

Ilion, N. Y.—Electric light bonds worth $25,000 were lately sold at auction to W. J. Hayes & Co., of Cleveland, O.

Jackson. Tenn.—An ordinance providing for the granting of the new proposed electric lighting franchise was lately passed.

Junction City, Ore.—The Junction City Manufacturing Company is planning to furnish electric lights for this place.

Keota, Ia.—The electric lighting plant here has been sold to Sigourney parties for $8,000. J. F. Kohlman, of Sigourney, is president of the new company.

Muncie, Ind.—The building of a new electric lighting plant has been proposed here.

New York Mills, N. Y.—A movement that may result in the lighting of the village streets with electricity has been started, and the matter is to be placed with the town board. F. C. Walcott is interested.

North Liberty, Ia.—The people of this place are talking of having electric lights.

Omaha, Neb.—The ordinance authorizing the submission to popular vote the question of issuing $500,000 bonds for the construction and appropriation of the purchase of conduits, subways and an electric street lighting plant, was recently passed by the city council.

Prospect, O.—A newly organized company, known as the Prospect Electric Light & Power Company, has been incorporated with a capital of $10,000. George Whysell, W. A. Black and others are interested.

South Jacksonville, Fla.—There is a movement on foot here to incorporate the town and establish an electric light and waterworks system. There is a waterworks plant here, but it is inadequate for fire purposes.

St. John, N. B.—The city council may decide to purchase the plant which provides electric lights for the west side of the city and run it as a civic enterprise.

Suisun City, Cal.—The city trustees have granted Leonard Prior a franchise for lighting this place with electric lights for a period of 25 years.

Watkins, N. Y.—The board of water and sewer commissioners has signed the $20,000 four per cent. bonds, issued for the construction of a municipal electric lighting plant, which were purchased by Farson, Leach & Co. of New York. The water and sewer commissioners, who by virtue of a special act of the legislature, will have charge of the construction of the lighting plant, will soon advertise for bids.

STREET RAILWAYS.

Aurora, Ind.—E. W. Swarthart and Harry R. McMullin, of this city, are back of a scheme to build an electric line between here and Rising Sun.

Brooklyn, N. Y.—The operation of Brooklyn Rapid Transit trolley cars across the Williamsburg Bridge will be begun on November 1, as promised by Commissioner Best.

Cleveland, O.—It is understood here that the Nickel Plate is to have electric motive power, and that when a similar change of power has been made on the West Shore the New York Central system will have an electric line from New York to Chicago.

Coatesville, Pa.—The Philadelphia, Coatesville & Lancaster Traction Company has secured the rights of way at Pomeroy.

Gainesville, Ga.—The Gainesville & Dahlonega Electric Railway Company is planning extensive improvements to its line.

Hamilton, Ont.—Hon. Charles D. Haines proposes to build an electric line from here to Brantford.

Hillsboro, Ill.—James H. Ward, of Butler Grove Township, has formulated a scheme for an interurban line of electric railroad running out of this place.

Marion, O.—A party of farmers and merchants of the vicinity of Galion, Iberia, Edison, Denmark and Adelaide, recently met a number of the members of the Commercial Club, for the purpose of discussing in an informal way the proposition to build an electric railway line to connect the towns mentioned with this city.

Mullica Hill, N. J.—An official of the Woodbury Trolley Company says: "The extension of the trolley road from Mantua to this place is an assured thing."

New Castle, Ind.—The county commissioners have granted a franchise for an electric line to Charles M. Mikels. The line is to run from Richmond to this city.

Norway, Mich.—William A. Lombard, of New York, representing an Eastern syndicate, has been in Dickinson County recently looking over the proposition to build an electric interurban line connecting this city, Iron Mountain and other nearby towns.

Paterson, N. J.--The management and directors of the Erie Railroad have under contemplation a number of plans for the improvement of the property, including one for the electrification of the suburban service throughout New Jersey. In all, the plans call for some $30,000,000, although they are only for the future and are provided for in financial arrangements already made. The plan for the electrification of the suburban lines calls for a central power station here, which puts the remotest point of the power delivery within a radius of 18 miles of the central station. Some 51 miles of road in all will be electrified.

Platteville, Wis.—To complete the electric road project between here and places in Iowa and Illinois, about $3,000,000 in bonds will be floated.

Ypsilanti, Mich.—The Detroit, Ypsilanti, Ann Arbor & Jackson Electric Railway Company is pushing all preparations for its new service.

POWER PLANTS.

Eatonton, Ga.—The Putnam Mills & Power Company has been incorporated with a capital of $75,000. It will develop water power. and erect an electric light plant to transmit power. James B. Floyd, Thomas B. Floyd and O.B. Nisbet are interested.

La Grange, Ill.—The La Grange Service Company has been incorporated by B. McKeever, G. C. Madison and others, to operate power plants. Its capital stock is $100,000.

Minnesota City, Minn.—A big electric power plant is to be erected on the Willingstone Creek in this city.

Salisbury, N. C.—That the work of developing the enormous water power available at the noted "narrows" on the Yadkin River, some 18 miles from this city, will be resumed and pushed to rapid completion, now seems practically assured. G. L. Whitney, of New York, president of the Whitney Reduction Company, and the company's secretary, F. L. Stephenson, have given notice that they, together with a company of surveyors and contractors, will shortly make full preparation for active work, and also to ascertain just what material and other requirements will be needed for the completion of the great plant which has been in contemplation at the "narrows" for some years. It is estimated that this work will cost not less than $5,000,000, and that enough power will be available to run one-half of the machinery in North Carolina.

San Francisco, Cal.—The Stanislaus Power Company has been incorporated with a capital of $5,000,000 by Sidney Sprout. J. P. O'Brien and others. It will supply cities and towns in the Central California Counties with light, heat and power.

Southlake Linden, Mich.—The Calumet & Hecla Mining Company is about to establish a mammoth electrical power plant convenient to its smelting works here,

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 13⅛@13¼c.; Lake 13¼@13⅜c.; casting, 13@13⅛c.

A quarterly dividend of 1¼ per cent. on Twin City Rapid Transit common has been declared, payable November 15.

The St. Louis Transit stockholders have ratified the action of the directors authorizing an issue of $10,000,000 improvement bonds.

Unless present plans change an assessment on Philadelphia Rapid Transit stock of $5 a share will be called either next month or in December.

Owing to certain requirements upon the part of the city of Baltimore local capital will not proceed with the financing of the Maryland Electric Company.

It is predicted confidently by General Electric people that in the near future the company will be doing a business of $15,000,000 a year in steam turbines.

A semi-annual dividend of $2.50 a share has been declared on the stock of the Edison Electric Illuminating Company of Brockton, Mass., payable November 1.

Calumet (Mich.) dispatches state that the September production of Lake copper was the largest on record, close to 90,000,000 pounds, valued at nearly $2,500,000.

The stockholders of the Oakland (Cal.) Traction Company will vote December 20 on issuing $7,000,000 bonds for refunding the retiring floating debt, extensions and improvements.

The stockholders of the Third Avenue Railroad Company and of the Fort George & Eleventh Avenue Railroad Companies of New York will hold their annual meeting on November 11.

The simultaneous advance in New York Metropolitan and Interborough stocks was based on the belief that terms might yet be arrived at for the merger of Interborough and Metropolitan Street Railway which would be acceptable to the leading interests in both companies,

The electrification of the Long Island Road, and facilities for reaching the business sections of New York through the Pennsylvania and Interborough tunnels, will place this road far in the lead of other lines for the quick handling of passengers from points along its lines to Manhattan.

Judge Grosscup's decision in the Chicago Union Traction depreciation case was purely an administrative ruling. He instructed the receivers to deduct 22 per cent. from the gross earnings of the North Side lines and 24 per cent. from the West Side lines, to cover depreciation and maintenance.

Through the recording of a mortgage given by the New York and Westchester Lighting Company to the Central Trust Company for $10,000,000, it was learned last Friday that the Westchester County Lighting Company and the New York and Westchester Lighting Company had merged their interests.

The Westinghouse Electric & Manufacturing Company, according to dispatches received in Wall Street Saturday from Pittsburg, is contemplating a bond issue of from $20,000,000 to $25,000,000 which will be available in 1905, to take up the $4,000,000 of first preferred stock at $100 a share; $2,679,000 of 5 per cent. debenture bonds and two short time loans of $2,000,000 and $4,000,000 respectively, floated through Kuhn, Loeb & Co. The dispatches had it that the bonds would bear interest at 5 per cent.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Oct. 24
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	162¾
Metropolitan Street Railway	127½
Metropolitan Securities	85¾
Ninth Avenue	197
Third Avenue	133
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	68½
Public Service Corporation (New Jersey)	104
Philadelphia.	
Consolidated Traction of New Jersey	75
Philadelphia Traction	98
Union Traction	56¾
Boston.	
Boston Elevated	154⅛
Massachusetts Electric Companies, com	12½
do. do. do. pref.	52½
West End Street, com	91¾
do. do. do. pref.	110
Chicago.	
City Railway	175
North Chicago	71
Union Traction, com	8¾
do. do. pref.	36

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Closing price Oct. 24
New York City.	
Allis-Chalmers, com	14⅞
do. pref.	61⅛
Electric Boat, com	40
do. do. pref.	73
Electric Lead Reduction	½
Electric Vehicle, com	16
do. do. pref.	22
Westinghouse, com	172
do. pref.	190½
General Electric	177
Boston.	
Edison Electric Illuminating	251
General Electric	176⅞
Westinghouse Electric & Mfg., com	86¾
do. do. do. pref.	95
Chicago.	
Chicago Edison	158
National Carbon, com	37
do. do. pref.	110
Philadelphia.	
Electric Company of America	9½
Electric Storage Battery, com	73
do. do. do. pref.	73

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price Oct. 24
Boston.	
American Telephone & Telegraph Company	144¾
Western Telephone Company	20
New England Telephone Company	134¼
New York.	
American Telegraph & Cable Company	92
Commercial Cable Company	210
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	91¾
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..

MISCELLANEOUS STOCKS.

Name.	Closing price Oct. 24
Otis Elevator Company	40
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

A Chance for an Electrical Education.

When inaccurate knowledge is contrasted with that which we term exact, a vast difference is at once apparent. It is evident not only to the unfortunate possessor of the first, but alarmingly so to the possessor of the second. In other words, a great danger arises from the spread of a mass of indefinite information, which, in a sense, has been the cause through which we find the representatives of every department of science, art, literature and the fine arts related to these, forming a distinct class from their brethren whose enlightment in similar fields is of a limited nature.

What is the remedy for such indefiniteness in the electrical science, in which department of thought, so much of absolute accuracy is required and in which, particularly with reference to the purely practical side, the requirements for a good foundation are so pressing?

Here is the remedy and the means it represents:

It is intended by the editor of ELECTRICITY to place before such of its readers as feel the need of exact knowledge on the subject of electricity in all its varied branches, a series of articles embracing a list of electrical principles and their applications, entitled "Electricity Leaflets."

Even those familiar with the subject of electricity in a special or a general way, will find it an advantage to obtain a concise review of the theoretical and operating field, couched in explicit and comparatively untechnical language.

The limited phraseology, in both a literary and technical sense, of the average reader is often a bar to his ambitions, and it is therefore necessary for those with the burden of so great a responsibility on their shoulders as that of treating scientific subjects understandingly, to follow in the footsteps of such great masters of the art as Huxley and Tyndall.

The readers of ELECTRICITY will have an opportunity of judging of the work of Newton Harrison, E. E., in a series of articles bearing his name, the first issue of which appears in this number.

If our readers gain a better knowledge of electricity through the brief sketches given each successive week then, perhaps, we can feel that this little notice has earned its title "A Chance for an Electrical Education."

* * *

A Triumph of Electrical Engineering.

If we could have resurrected the long gone and buried past and placed beside the Mayor of New York, the contractor, the engineer and the financier of the new subway, one of the high priests of ancient Greece, clothed in the garments of his high office with his hand clasping a piece of amber, a picture would be presented that would rightly link Hellenic ideals with the colossal conceptions of the new western world.

The poetic dream of some pantheistic adorer gave amber immortal fame, and from the spirit contained within it, dug out, as it were, from the buried history of the earth, has in reality sprung this tremendous genie whose arms have welded together the distant continents, given speech and thought, unlimited scope and supplied the great factories of the world with a new and wonderful power.

The New York Subway will always be classed among the great accomplishments of this nation. Unless it be the tunnel through the Alps there is nothing, not even the Penny tube in London, to compare with so vast and so successful an undertaking.

New York City will now be honey-

combed, and a new phase of its existence will begin—subterranean New York.

Skyscrapers cannot be raised any higher, who knows to what depths they will in the future be sunk.

The first night, October 27, at 7 o'clock was the occasion on which 150,000 people paid tribute to the enterprise, brains and skill which created a structure so useful and so perfect.

With power circuits distinct from those that supply light, the light is safe when the power is cut off.

Collisions are almost impossible on account of automatic braking devices when the trains approach too closely. If the motorman is stricken at his post the release of his hand from the controller stops the train.

With the tracks for local trains distinct from those used for express lines the rapid transit so long hoped for has become a reality, and it is now possible to annihilate space, beneath the busy thoroughfares without fear of interruption or accident.

It is true that "though the mills of God grind slowly, yet they grind exceeding small." This plan, proposed over 30 years ago, when the people of New York had not quite realized what conditions existed around them and what problems were to confront them in the near future, became in that period of time an enormous proposition—the building of which in the days of the original planning would have been regarded as an act of municipal madness.

What does it mean to-day? It means that the rate of growth of New York is so prodigious that the transit facilities can never catch up with enormous congestion bound to result in several centers. With pure air in the tunnels and a perfect electrical system in operation the New York people have every reason to congratulate themselves, and the authors of this triumph of electrical engineering.

* * *

Foreign Markets. The United States has gained a high place among the world's commercial nations and it is mainly because of its manufactures that the attention of the world is directed to this country. American electrical machinery and electrical appliances of all kinds are now going into all parts of the world and an especially gratifying feature of these exports is the success with which they compete with the best productions of Europe. Another interesting fact in this export trade is that the productions that go out are not mere surplus stock. A regular trade is being catered for and is being built up on precisely the same basis as that upon which our domestic trade was built up.

A glance at the export tables prepared by the Government statisticians shows that American electrical apparatus and appliances find favor in almost every part of the world. When a falling off is recorded it is usually caused by financial stringencies in the countries reported on, or to the efforts to restrict importations by the enactment of restraining regulations. Right here it may be said that no easy task awaits those seeking to enter the foreign markets. Competition was never so keen. Success based upon the mere selling of surplus stock is no longer the object of these efforts. A permanent position for goods designed for the foreign markets is almost as much a necessity as is a production of goods for the home market. The foreign departments of many concerns are actively engaged in increasing their sales in markets already secured, and in extending their trade in markets that have hardly been touched upon up to this time. As American exports increase the producers in other countries will be spurred on to increased efforts. Nobody knows this better than do those captains of industry who have succeeded best in the foreign field. Manufacturers must be prepared for all kinds of opposition. Everything will be done to weaken our present position in order, if possible, to prevent further progress. To win in the world's markets they must go after trade like their competitors abroad. All the world is at work to improve its industrial and commercial conditions, and the United States will have to fight harder than ever to retain the position it has won in the world's markets. The electrical industry has made wonderful strides in conquering foreign fields and it may be expected to jealously guard its conquests and not permit other countries to step in and take away what has been won by hard fighting.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The 25th anniversary of the introduction of electric traction into Germay will soon be celebrated in Berlin.

The National Electric Light Association is about starting an active campaign for new members, and the appointment of Mr. Henry L. Doherty as committee on membership promises well for the success of the campaign. The great increase in membership in the past two or three years was largely due to Mr. Doherty's personal efforts and methods suggested by him, and now that he has taken the matter up officially large results may be looked for. At the last meeting there were three new classes of membership created, and it is in these classes particularly that the increase is expected. Officers and employes of member companies are to be received as members, with the written consent of the member company with whom connected. The entrance fee for such members will be $5 and the annual dues $5. They will receive the various publications issued by the association throughout the year, so this is a very low rate for dues.

The Navy Department expects this week to have in successful operation from the Nantucket Lightship its new system of wireless telegraphy, with which it is intended to communicate with all passing steamers, and especially to give advance orders to naval vessels going up or down the Atlantic Coast. Admiral Manney, Chief of the Equipment Bureau, in charge of this service, for months has been engaged in getting the necessary plant and installing it on the lightship. Tests made with a temporary plant have satisfied the operators that they can not only communicate with Newport, the nearest shore point to the lightship, but even as far as Navesink, on the New Jersey shore, nearly 200 miles distant.

Fire Commissioner Hayes of this city has announced that he intends soon to ask for an appropriation to extend a system of fire alarm boxes to the elevated railroad stations. An experimental system has been in use along the Third Avenue line from 67th street to Hanover Square for several months. Commissioner Hayes will now seek to extend the boxes south on the Second Avenue line from Hanover Square to South Ferry and up the Ninth Avenue line to 59th street.

A subway system for Chicago will be started before April, 1906, according to Milton J. Foreman, chairman of the Transportation Committee of the city council. The subway will accommodate through traffic. Surface cars will continue to carry local traffic. The tunnel, if the present plans are carried out, will be divided into four compartments. Two of these will be for railways, the others for such public utilities as heating and refrigerating plants, high water pressure pipes and electric wires. The present river tunnels will be utilized in the new system. A fund of $2,000,000 is on hand for the beginning of the work, Mr. Foreman stated.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, F. F.

STATIC ELECTRICITY.

Historical.—What other ancient annals, than the Greek could show, has escaped the searching eye of the investigator, and there is but one reliable record in consequence to fall back upon, in tracing the history of electrical discovery.

Greece, with her art, her literature and philosophy, has left her stamp upon the other great nations whose destinies have so far been largely moulded by the thought which emanated from these classic times. And it cannot be said that this was all, for vaster influences sprang from the buried seed of learning, even though such knowledge was shrouded in the mists of mythology. Thales, the Greek philosopher, remarked upon the curious properties of amber. To such as he, a prototype of Greek paganism and metaphysical thought, there lay within this strange relic of primeval days, a wonderful soul. The soul of amber, as it was called, gave evidence of its existence when the amber was rubbed upon the garments. A strange influence was emitted from the precious gum, and drew towards it light bodies, such as cotton threads and wisps of straw. And so, this unique property of amber was recorded by the sage, and handed down to another nation after the passage of more than 2,000 years, to become the subject of new interest and inquiry, from a standpoint, however, which stripped it of its mythological character and fortunately gave rise to a series of new propositions of enormous interest and ultimate benefit to mankind.

The period of the renaissance proved an awakening, not only to the world of art and letters, but gave rise to a new manner of thinking, which ushered in the birth of science. Dr. Gilbert, one of the exponents of this new idea, physician in the reign of Queen Elizabeth, investigated the properties of amber in conjunction with a series of other substances, and thus was enabled to find in them all a similarity of effects occurring which dissipated the doctrine of spiritual influences forever as far as this particular substance was concerned. The Greek name elektron, however, which means amber, has been preserved and embodied in the word electricity.

Energy.—The question is often asked "What is electricity?" and the answer generally given is ambiguous and misleading. If the question referred to chemical affinity, the expansion of gases, the nature of cohesion or the secret of gravitation, it would perhaps, in the light of our present knowledge and experience, be more difficult to answer than the one propounded. Electricity, like light and heat, is a form of energy, yet the significance of this expression is lost unless a clear idea of its meaning and relationship to other manifestations of energy is obtained. The word energy conveys an idea, which is of the deepest interest to the mathematician and those engaged in the consideration of practical and abstract propositions of science. For that reason at least, it is necessary to grasp the ultimate connection existing between what might be called the different phases of energy, and the meaning which the word conveys when it is isolated from any other relationship.

It may be understood from the beginning, that the theory and practice of electrical principles cannot, in any way, shape or form, be dissociated from the fact, that as energy it is either transmitted and transformed, or both. Whether it be electric lighting, electro-plating, electro-metallurgy or electric power transmission, the same idea will repeatedly and necessarily appear. In other words, the entire field of electrical engineering with its immense scope and innumerable applications to domestic, municipal and national purposes, represents in total an effort to produce an effect at a point more or less distant from the source of power; and for this reason, a comprehensive study of the subject of electricity at once yields this fact, that energy in a multitude of forms must be provided and the mechanism through which this can be accomplished, constructed.

Source of Terrestrial Energy.—The sun, with its system of planets, represents a condition which is duplicated a thousand times in the visible and invisible portions of space. From an astronomic standpoint, the probabilities are that the eyesight of man though armed and extended, by such triumphs of the optical art as the great Lick telescope, fails to pierce the recesses of space beyond a certain circumscribed distance. Beyond this limit there may be worlds upon worlds, constellations upon constellations, pursuing their mysterious destinies unseen, unknown and almost unimaginable, except with respect to the systems within our sight.

As far as human knowledge is concerned they all obey a series of laws, and observation has shown that these laws can be relied upon in mapping out the courses of the stars and the orbits of all planets.

By means of spectrum analysis, it is possible to analyze the composition of incandescent masses millions of miles away, and it has thus been possible to identify the general composition of the sun 92,000,000 miles away, with that of the earth, and other satellites. Thus it seems that the mother world was the sun, and from it, in times too remote for human imagination to measure in other than millions of years, was cast, successfully, huge semi-vaporous or molten masses which in the course of vast periods of time, resolved themselves into the planetary system of which the sun is the gigantic center. Thus it becomes evident that the original source of terrestrial energy in common with that of Mars, Jupiter, Saturn and the other planets is the sun. The rise and fall of the tides, the winds, the rains, the seasons, the variations of temperature are all caused directly or indirectly by the sun; and among the most dramatic and most familiar of the phenomena derived from the sun's energy is that which is termed, lightning.

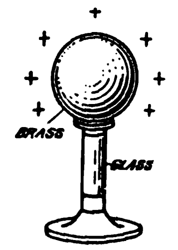
But electrical manifestations do not cease with this. At the artic and antarctic regions of the North and South poles, magnificent exhibitions of the aurora borealis take place, distinct revelations of the presence of electrical and magnetic energy; and in these regions may also be found the magnetic north and south poles of the earth. Powerful earth currents pass unceasingly around the globe and it has been frequently noted that invisible magnetic storms sweep over the surface of the earth, unknown to any but those equipped with the requisite knowledge and means of detection. On the surface of the sun every eleven years, on such periodic occasions, spots are discovered which are known to astronomers as vast cyclonic disturbances, creating waves of fiery matter 50,000 miles high. It is the coincidence of these events, the auroral light, earth currents, magnetic storms and sun spots, that has led to the belief that across the 92,000,000 miles of luminiferous ether tremendous influences are projected, of which this earth receives its quota. It is possible to faintly imagine the gigantic nature of these outbursts when it is realized that the sun has 1,000,000 times the mass of the earth, and though separated from it by such an enormous void of space is still capable of exercising so marked an influence upon its general state of electrical equilibrium.

It seems, at this writing, to be the belief of the most advanced scientific thinkers of the day, that we must look to the sun for an explanation of the majority of the electrical phenomena just cited,

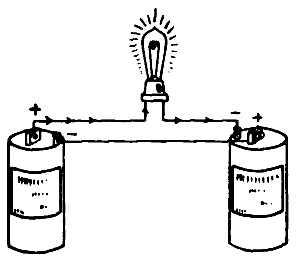
and there is every probability that the earth is constantly exposed to an electrical radiation, consisting of the projection of infinitesimal but heavily charged elements of matter, passing with an enormous velocity across the intervening space which separates the earth and the sun.

The source of terrestrial energy is the sun; not only as regards the forms of latent and potential energy embodied in physical and chemical changes, but it is even now receiving new additions of energy of which the light and heat of the sun cannot be alone considered, as they would not be sufficient to adequately account for several of the most familiar of the natural phenomena. New scientific explanations are required for these, and they may be partly found in some of the new hypothesis advanced in the field of static electricity.

What is Static Electricity?—Electricity can be generally divided into two kinds—static and dynamic. Static electricity means electricity at rest. Dynamic electricity means electricity in motion. As an illustration of what is meant by static electricity take a metal globe insulated by means of a glass support and charge it with static electricity. This is a case of electricity at rest. On the other hand,



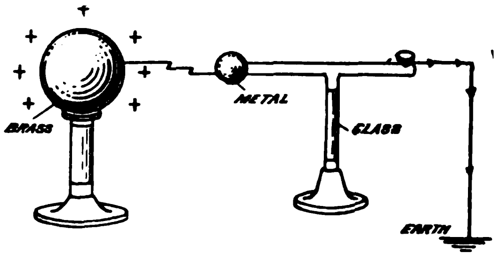
Electricity at rest.
SPHERE CHARGED WITH STATIC ELECTRCITY.



Electricity in motion.
ELECTRICITY PASSING THROUGH LAMP AND CELLS.

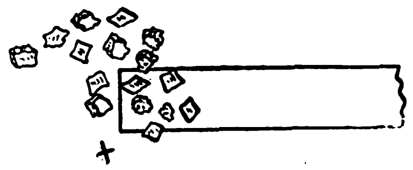
take a source of electric current such as a couple of dry cells and connect the terminals through a small lamp. In this case the electricity is in motion, and is thereby distinguished from the static. The theory of static and dynamic electricity indicates this difference between the two, which is expressed numerically as the velocity of light, or 186,000 miles per second. In other words, it seems as if it is merely necessary to impart motion to a static charge to give it all the characteristics of a current.

Motion to a Static Charge.—If the charged metal globe is allowed to discharge its electricity through a wire, it becomes transformed into dynamic electricity and exercises the same effects as a current of the same character. This has been noted a number of times in the case of lightning discharges, where melting, burning and decomposition have been caused by the escaping electricity, originally static in character and for the instant possessing those qualifications which define it as dynamic.



STATIC ELECTRICITY MOVING WHEN DISCHARGED THROUGH A WIRE.

Producing Static Electricity.—Nearly all chemical and physical changes produce electricity. Static electricity can be produced in great quantities by means of friction and by applying certain principles of static electricity to the construction of machines through which mechanical or muscular energy is transformed into static electricity. A common way of developing static electricity for experi-



ROD ATTRACTING LIGHT PARTICLES OF CORK AND PAPER.

mental purposes, is to use a glass rod free from lead, and rub it with a silk handkerchief or secure a rod of hard rubber and apply friction to it by means of a woolen cloth. If the air is dry, sufficient electricity can be obtained to produce violent reactions with small pieces of light paper, fragments of cork, etc. Benjamin Franklin in his experiments used a glass globe mounted on a horizontal axis, against which a rubbing cushion pressed, thus producing static electricity.

The Scientific Basis.—To deal with the subject of electricity in a manner which expresses exactness, it is necessary to base all units upon some foundation which can be considered as unchangeable.

An international agreement has been reached in this respect, with the result that the units of length, weight and time which are employed, are the centimeter, gramme and second. Another name or combination of names given to these units is the absolute or C.G.S. system.

From these units are derived all elements of force or work by means of which the phenomena of electrical actions and reactions can be expressed so as to be comprehensible to the theoretical and practical man.

The fundamental idea of energy is in a sense metaphysical, yet it is defined as the capacity of a body to do work. Force is defined as that which moves or tends to move a body from a condition of rest to motion or motion to rest. Work is defined as the action of a force in overcoming resistance. There are, therefore, the ideas of energy, force and work, upon which the structure entitled the electrical science is reared and without which it is impossible to measure the relationship between cause or effect, or one form of energy and another, in an exact and practical manner.

It is unnecessary, therefore, to regard electricity as an incomprehensible phenomenon, because there is more known about it than about a variety of other manifestations of energy. Yet the fact remains that electricity is capable of so many remarkable applications, that even though its exact nature was better known, this would not in the least detract from the immense interest attached to its varied usefulness. Take away from civilization the telegraph, the telephone and the Atlantic cable, and it would seem as though a century's retrogression has ensued, instead of progress. Remove the electric light and electric car from large cities and municipal chaos would result. It becomes evident that the old-time luxuries of life rapidly become the necessities of to-day, and it can be easily shown that the influence of electrical inventions in social and business life has been one of the most potent factors in the worlds progress.

THE BUDAPEST TELEPHONE EXCHANGE.*

When, in 1897, the Hungarian Telegraph Administration took over the Budapest Telephone Company, it was well known that not only would the subscribers' lines need to be changed from single wire to metallic circuits, as had already been done in the other Hungarian exchanges, but also that a new and modern switchboard must replace the four antiquated central offices. After a careful study of the local conditions it was decided to concentrate all the Budapest subscribers in a single central office in order to attain the highest operating efficiency. Since, in spite of unfavorable circumstances, the number of subscribers was already between 5,000 and 6,000, it was desirable to make the new central office of very large capacity.

Tenders for the new plant were invited and that of the Western Electric Company was accepted, in combination with

*From the "Electrician," London.

the Hungarian United Electric Society of Budapest-Ujpest. The central battery system was adopted, with a preliminary equipment for 10,000 subscribers and a capacity of 20,000. The switchboard occupies one side of the switch room, on the other side of which is space for a second board of the same capacity, so that the new exchange will be capable of accommodating 40,000 subscribers. We believe that no single central office of these dimensions has yet been built anywhere, and a description of the main technical features of this plant will therefore be of interest.

For the building 2,500 square meters of ground was purchased at about the center of the exchange system. A six-story building was erected at a cost of £60,000, and was fitted with modern heating, lighting and ventilating appliances. This building occupies the whole space between two parallel streets, and the switch room, 64 by 10 meters and 7 meters high, runs lengthwise of the building. Immediately under the switch room is a low story, 2.30 meters high, containing the intermediate distributing board, the relay racks, etc. There is a passage to the lower room under the switchboard at each operator's place. The switchboard cables thus pass directly to the intermediate distributing board, and the relay rack. Similar openings are provided in the floor on the other side of the room for the second switchboard. Three spiral staircases lead from the switch room to the floor below, and near the central one is a broad staircase for the use of the operators in entering and leaving the switch room. There are two chief operators' desks set near the wall opposite the switchboard, destined to be moved to the center of the room when the space is wanted for the second row of switchboards.

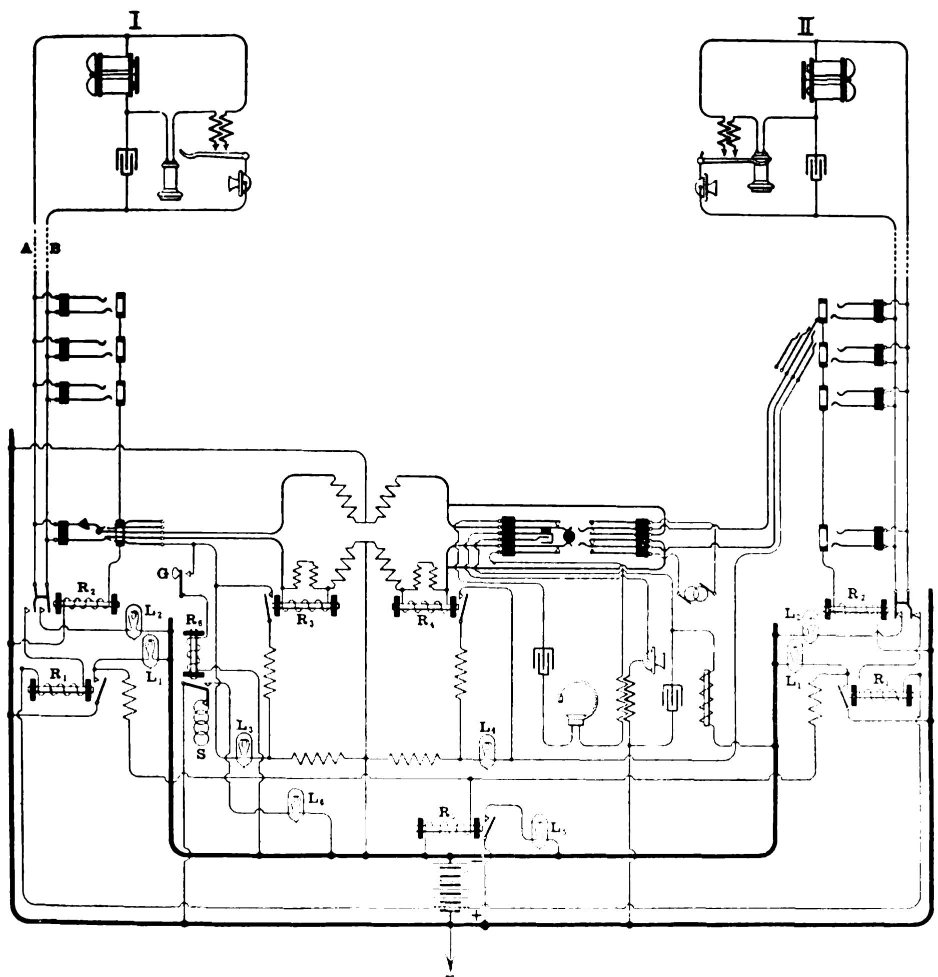


FIG. 1.—SUBSCRIBERS' LINE CIRCUITS AND CORD CIRCUITS.

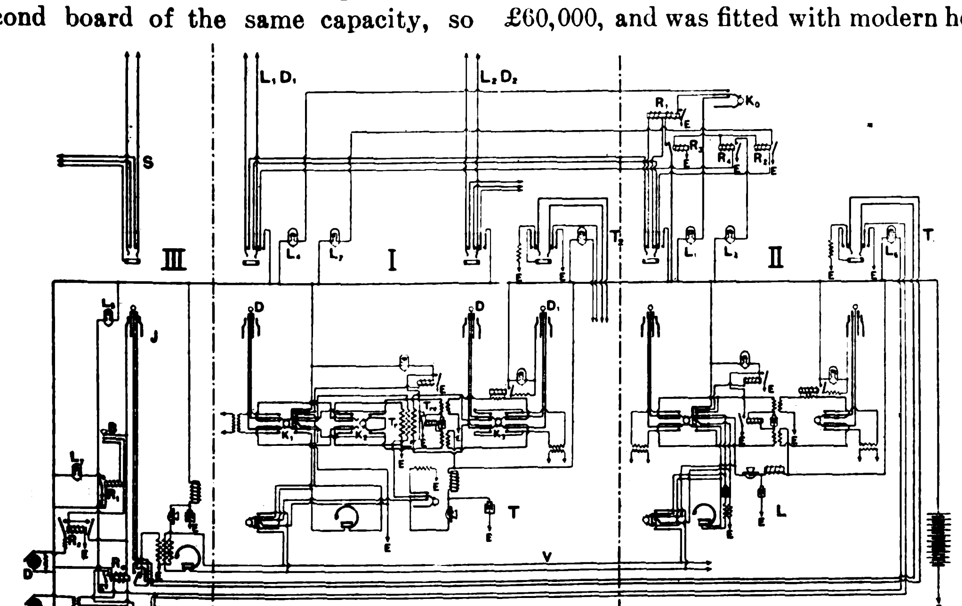


FIG. 2.—TRUNK CONNECTIONS.

The present row of switchboards begins with a trunk junction section for three operators, each of whom has 40 single cords connected to the trunk room. All the subscribers' jacks are multiplied in this section, so that these operators can give direct connection to any subscriber in the exchange when required for the trunk service. This section, which is provided with nine panels of jacks, is slightly separated from the 22 subscribers' sections which follow.

Each of the latter has three operators' positions equipped for 150 subscribers each, there being a 67th position equipped for 100 subscribers, thus making a total equipment for exactly 10,000 subscribers' lines. "Dummy" sections are provided at the beginning and end of the row repeating one-third of the 10,000 subscribers' jacks in the usual manner. The subscribers' sections are 1.80 meters long and contain 10 panels of jacks, so that the numbering with a thousand jacks in each row of hundreds is decimal and perfectly symmetrical. Each operator's position is provided with 15 pairs of plugs and cords and with the corresponding listening and ringing keys arranged in the usual manner. The circuit is shown in Fig. 1, where the calling subscriber I is shown connected with the exchange, while the called subscribers' jack is being tested. The number of connections at each operator's position is registered by the operator who, on pressing the button G, actuates the recording mechanism S, after completing each connection.

For the detection of earth faults, the B-line is connected through a lamp L_2, with the negative pole of the battery, the A-line being connected with the bus bar

of the ninth cell through the line relay R_1. If there is an earth on the A-line, the line relay R_1 is operated, whereas in case of an earth on the B-line the lamp L_2 is lighted by current from the 11-cell battery. The subscribers' transmitters are supplied from the entire storage battery.

The street cables are lead-covered, and have been laid in cement conduits of the Hultman type. They enter the building in the basement, where the main distributing board is placed. From here small lead-covered cables pass up through a cable shaft to the switch room. The power plant and storage battery are placed in close proximity to the switchboard and the relay racks, thus making the battery leads very short and consequently reducing the drop of potential to the requisite limits.

Adjoining the main switch room is the trunk room, where all trunk line connections are made. The plant here includes one test board, one transit or through trunk board with two operators' positions, three rows of trunk boards with six positions each and six trunk lines per position, one subscribers' recording board, and one trunk recording board for 120 special trunk-line subscribers whose lines end directly on this board. This latter board has three operators' positions for 40 lines each, and the lines of these special trunk subscribers are multiplied on the trunk boards and the transit board.

As the trunk lines in Hungary are used for simultaneous telegraphy and telephony and also for duplex working, it was found necessary to devise special circuits, shown in Fig. 2, to adapt the lines to these requirements. Section I represents the transit board circuit, which is used during the day for completing through trunk line connections; at night all trunk connections are made on this board. Section II shows the circuits of the trunk boards. Section III shows the circuits of the trunk junction section, which is located in the general switch room.

The trunk line L_1D_1 comes first to the transit board, whence it passes through a break jack to the trunk board, there ending in a line relay, R_1, with a retaining coil. If the key K_0 is in the position shown when a call occurs, the calling lamp L_1 is lighted. Plugging the jack actuates the relays R_2 and R_3. Relay R_2 lights the lamp L_2 on the transit board, notifying the operator there that the circuit in question is engaged. Relay R_3 interrupts the circuit of the retaining coil of the calling relay R_1. If the trunk line is in use at the transit board, relays R_3 and R_4 are actuated, and through R_4 the lamp L_3 is lighted, notifying the trunk line operator that the line is engaged at the transit board. To concentrate the whole trunk line service at the transit board, the lever of key K_0 is thrown over, and now all the calls are received on the lamp L_4 of the transit board. The two portions of the cord circuit L, that is, the trunk to the left and the local subscriber to the right, are connected by a repeating coil, including on one side a condenser, and on the other the central battery which supplies current to the subscribers' transmitters. The trunk circuits are, therefore, completely insulated. and simultaneous or duplex operation is in no way hindered.

Plugging into the junction jack at T_1 actuates the differential relay R_d and lights the lamps L_5 and L_6. The number of the desired subscriber is given to the operator at the trunk junction board in the general switch room over the order wire V. With the plug J of the junction line corresponding to the jack T_1, the operator tests the jack of the desired subscriber's line. Through the normal contact of the test relay R the tip of the plug is in connection with the third winding of the induction coil of the operator's set, so that, if the subscribers's line is already connected to a local circuit, the operator hears the click in her telephone.

If, on the other hand, the subscriber's line is connected with a trunk line, she hears a buzz or tone. In the first case the connection is cut off, as toll line connections are always given precedence over the local service; in the second case, the line is not disturbed. This cutting off is readily done, as each subscriber's line passes through a break jack on the trunk board in the general switch room, as already mentioned. In order to explain the interruption to the second subscriber (the first being picked up at once by the toll operator), and to disconnect him quickly, the trunk junction operator depresses the key B associated with each cord circuit, which locks the rely R_z to the third core conductor. The low-speed interrupter D is thus connected to the test ring of the subscriber's line, and causes the supervisory lamp at the subscriber's operator's position to flash at distinct intervals. On perceiving this unmistakable signal, the subscriber's operator tells the second subscriber that the first has been called by the trunk room, and disconnects the line. This disconnection causes the relay R_z to drop its armature, thus cutting off again the intermittent current from the third conductor. Pressing the key B, also actuates the relay R_t and lights the lamp L_y, indicating that the intermittent current circuit has been completed.

As already mentioned, it is also possible to ascertain by testing whether a subscriber is in connection with a trunk line. Through the third conductor of the cord, which places testing potential on the test-rings of the multiple jacks, the battery current traverses the winding of the test relay R_c. This relay has, however, a second winding which, by induction, superposes, on the constant current flowing, an intermittent current of high frequency from the high-speed interrupter D_1. In testing, the operator then hears a buzz or tone in her headgear receiver, informing her of the trunk line connection.

As already mentioned, the transit board performs a double duty. In the hours of heavy traffic the through connections of trunk lines are made here. During light traffic it can be arranged that all trunk room connections, including those of the recording and trunk subscribers' lines, can be effected in addition to inter-connecting trunk lines. For this purpose the board is provided with three sets of cords and plugs. Plug D_l can be used only for trunk line jacks, being too small for the local jacks, whereas the plug D_1 fits the latter. If the third key K_2 is in the position shown only the two plugs D_l D_l can be removed, the plug D_l being held in place mechanically. Therefore only a connection between trunk lines can be made, and this only through the translator T_r. This latter is designed to serve also as clearing relay controlling the clearing lamp. If, on the other hand, a trunk line is to be connected to a subscriber's line, the lever key K_2 is thrown over, thus freeing the plug D_1 and mechanically locking the neighboring plug D_l. The cord connection is then completed through the repeating coil T_{re}, which is of the same construction as the repeating coil of the trunk line cords and similarly connected. The trunk line circuits are thus kept separate.

All order tickets are sent to the different boards, and thence after use to the counting office by means of a special pneumatic tube distributing system, in which the tickets themselves are transported without carriers. The duration of trunk-line conversations is timed by three-minute clocks, the exact time being recorded on the tickets by a calculagraph. The operators at the recording tables are informed of the number of orders for each trunk line at any moment by colored lamps, and are thus able to inform the subscriber beforehand approximately when the trunk line called for will be available.

The operation of the entire installation is very regular and goes on with precision, ease and smoothness. The whole installation has proved very satisfactory and does credit to both manufacturers and designers.

ELECTRICAL PURIFICATION OF DRINKING WATER *

BY JOHN W. LANGLEY.

This paper deals with the sanitary purification of water for domestic purposes.

Attempts to destroy bacteria by the direct action of electric charges did not result in any marked success. Milk was the fluid used, and static charges as high as 150,000 volts from condensers of one-seventh of a microfarad capacity were sent through 20 cubic centimeters in sterilized vessels, but the milk so treated soured only six hours later than a sample of the same milk not electrolyzed.

Substantially the same results followed the application of alternating currents of 500 volts having a frequency of 66 cycles for 10 minutes.

It has long been known that electricity has a lethal action on bacteria through the chemical changes produced by electrolysis. As long ago as 1892 work on the purification of a sewage mixed with sea water was carried out on a commercial scale near Yonkers, N. Y. Here the chlorine produced from the salt in the water was the germicide, the electrodes being carbon and iron plates. This process has also been recently applied in England on a scale of nearly a million gallons a day, iron plates at both anode and cathode being used.

The most successful method of electrolysis for drinking water is by the use of aluminum plates as electrodes. A plant for this purpose is working commercially in Cleveland, Ohio. The electrolyzer is a rectangular iron box. The aluminum plates are held in grooves in a slate lining. The application of 20 amperes at 15 volts, or 300 watts, in the form of a continuous current, produces sufficient electrolysis to purify 500 gallons per hour of Lake Erie water. The water flows in a continuous stream from the city supply through the apparatus. The action is to produce aluminum hydroxide, which, as has been long known, combines chemically with the coloring matter and most of the organic matter, and mechanically entangles all solid particles including bacteria and fungi. The water issuing from the electrolyzer is milky from suspended aluminum hydroxide and passes to a filter filled with crushed quartz, which arrests the solid matter. The effluent from the filter is colorless and of great brilliancy.

Chemical analyses show the albumenoid ammonia to be greatly reduced, usually upward of 75 per cent., and is brought down well within the limits specified by the Michigan State Board of Health, which calls for a greater degree of purification than generally called for by other States. The free ammonia is always increased, because of the electrolytic action changing a portion of the dangerous albumenoid ammonia (or of the nitrogenous matter which produces it) into the harmless free ammonia. The dissolved oxygen is increased and the organic matter which reduces permanganate of potash is diminished about one-half. No important change is made in the chlorine, but the temporary hardness due to bicarbonate of calcium is almost completely removed.

The action on the bacteria is very satisfactory. These are reduced on the average 97 per cent., and several analyses have shown a reduction of over 99 per cent. Moreover, those which pass the filter are of the harmless water-bacteria type, for in no instance in six months of continuous commercial operation has a single colon bacillus been found, though the lake water generally contains them. This result has been substantiated by weekly and semi-weekly bacterial tests.

The electrolysis evolves much hydrogen and a smaller portion of oxygen than the two-to-one ratio due to the composition of water. As the apparatus is under the city pressure, these gases are partially dissolved, so that the purified water is more fully aerated than the original lake water, which adds greatly to its palatability and to its hygienic value.

*Paper presented before Section H of the International Electrical Congress, held at St. Louis, Mo., September 12-17, 1904.

THE TELEGRAPH, TELEPHONE AND CABLE IN WAR.*

BY MAJOR SAMUEL REBER, U. S. A.

(*Concluded from page 231.*)

France did not, until 1868, establish any definite military system, although a number of experiments had been made for a series of years, when a military telegraph organization was adopted. This organization does not appear to have worked in a satisfactory manner during the Franco-Prussian war and fell into the hands of the Germans at the capitulation of Metz. The Germans employed the telegraph extensively during the war, its use contributing in a marked degree to their success. Their three armies were connected to their bases and the home Government. At Strassburg the telegraph line was carried to the third parallel, and was of great assistance in directing the artillery fire. The siege of Paris would probably not have been successful without the use of the telegraph, for the lines of investment were 46 miles in length with about 4,000 men per mile, the besiegers being less numerous than the besieged. During the three days' fight on the Lisaine where von Worder, who was covering the siege of Belfort, was attacked by Bourbaki, it was due to the thorough telegraphic communication which had been established by the Germans that the timely arrival of the reserves from the extreme right was effected as was their subsequent return there at a critical moment. At the close of the war the Prussians had in operation 6,730 miles of field wire with 407 stations.

The military system of Spain which had been developed during the Morocco war had been improved. At the battle of Alcoba, the Spanish commander was in constant communication with Madrid, and the field telegraph was an indispensable aid to General Prim in putting down the Republican and Carlist insurrections. During the Civil War in 1873 the field telegraph was in constant use, and in the defense of Bilboa the weak garrison was enabled to hold the extensive works by concentration ordered by telegraph at the threatened points.

During the Turko-Russian war the Turks had no special field telegraph corps, although some permanent lines were built for military purposes. The Russians, however, used field and outpost telegraphs extensively, constructing 1,344 versts of line in the Balkan Peninsula and 1,034 versts during the Asiatic campaign. The following incident in the Asiatic campaign is an example of its value to the Russians: In the operations in the Kurukdere mountains against Mukhtar Pasha, General Lazereff was ordered to march around the Turkish right, passing along its rear and cutting Mukhtar's force off from Kars, and placing him between the two Russian forces. After severe fighting Lazereff obtained possession of Mount Oghur, a strongly fortified point which connected the Pasha with Kars. From this point Lazereff telegraphed the Grand Duke over the field line, which had kept pace with his movements, that he was confronted by a superior force and a simultaneous attack by the Grand Duke's and his own troops was

*Paper presented before Section G, Electric Communication, at the International Electrical Congress, held at St. Louis, Mo., September 12-17, 1904.

needed to extricate him from his critical position. The dispatch reached the Grand Duke in such time that the simultaneous attack the following morning led to the total destruction of the Turkish army.

The development of the military telegraph system of the English army appears to have progressed quite slowly at first, as its importance does not seem to have been recognized by the authorities. When the Ashantee war of 1873 broke out no field telegraph material existed in the army, and none reached the troops in the field until they were well into the interior. When the supplies were received they were both insufficient and unsuitable, but assisted in hastening the termination of the war. Again in the Zulu war in 1879, no provision seems to have been made at the beginning of the campaign. Better use of the telegraph was made in the Afghan campaign of that same year in the face of great difficulties of operation caused by the constant cutting of the lines by the enemy.

In 1881, Major Cardew introduced the telephone as a receiver for telegraph purposes, using a buzzing note produced by an interrupted current for transmitting Morse characters. This system has been modified and extensively used with great success in our own service. The buzzer, as it is called, is simply a coil of low resistance and high self-induction in circuit with a telegraph key, an interrupter and a few cells of dry battery. On opening the circuit the discharge from the coil goes to the line, and owing to the high self-induction and consequent comparatively high EMF. enough current reaches the other end of the line to give audible signals. By the use of the buzzer leaky and broken lines which would be absolutely grounded for ordinary Morse working can be operated. Major Cardew's system was first used in the Egyptian campaign of 1882. The telegram announcing the result of Tel-el-Kebir was sent from the battlefield by this system. Profiting by their previous experiences, about which an English writer of high authority in 1894 naively said: "Some ill-luck seems to have attended our telegraph arrangements on service," the British had a completely equipped and supplied telegraph organization in the field during the recent Boer war in South Africa. Some 220 separate field cable-lines of 3,749 miles in length, and 2,191 miles of aerial line were constructed by them, the traffic on some of their main trunks being so heavy that they used Wheatstone automatic instruments. The telephone was also extensively used. The defense of Ladysmith was conducted entirely by telephone, and it was said that the telephone system saved the place when the Boers attacked Wagon Hill and Cæsar's Camp on January 6, 1900. To protect their long line of communication against the raids of the Boers, blockhouses were built at intervals of about 1,000 yards and every second or third one supplied with a telephone connected with centers for the dissemination of information and for the obtaining of succor. Certain of the blockhouses were supplied with telegraph instruments in addition to the telephone. "The blockhouses together with the systematic 'drives' organized by the Commander-in-chief finished the war, as the Boers themselves confess."

In the Spanish-American war, though of short duration, the telegraph, telephone and cable played a most important part, both strategically and tactically. In the operations in front of Santiago the telephone was used to connect the trenches along the 13 miles of front. The bombardment of Santiago was directed by telephoning from the front to the shore, where range and direction were flagged to the fleet. The operations are summed up in the following extract from the official report of the chief signal officer for 1898:

"The major-general commanding the Fifth Army Corps reached by telephone points on the right, center, and left of his line within 400 yards of the enemy, and communication with his subordinate commanders was not only possible at all times, but was continuously maintained, as these lines worked 24 hours in the day. On the other hand, the major-general commanding the Fifth Corps was able to communicate directly with the admiral commanding the fleet through the telephonic station near Aguadores. In addition, the War Department, with all its bureaus and the supply depots of a great nation, were within 20 minutes of the general commanding, so that any deficiencies of equipment could be asked for or re-enforcements requested; and further, he was able to keep in touch with the President, the Secretary of War and the Commanding-General of the Army, so as to receive at critical moments such advice, encouragement or assistance as might advance the interests of the campaign."

In the Porto Rican campaign every part of the widely distributed invading army was connected by telegraph and telephone from the first day of landing at Guanica to the termination of the war. The telegraphic and telephonic service was such that within 33 minutes after the receipt of the cablegram announcing the armistice which suspended hostilities the commanders of three separate divisions of the army operating in different parts of the island miles apart were ordered to suspend operations. In the case of two of the commands the message arrived just in time to prevent actual contact as the troops were in position for action, and at Guayama held the lanyards stretched on the guns to open the artillery duel. In the Philippine campaign and the subsequent insurrection, the telegraph and telephone were of great value, so much so, that the Commander-General remarked in 1901: "It is not so much to say that in the absence of this efficient service it would be impossible to hold this archipelago with less than 150,000 men, which is now well and efficiently held by 60,000." During the insurrection some 4,851 miles of aerial line were constructed and 500 miles of submarine cable laid.

In the present war between Russia and Japan it can be inferred from the meager published reports of the operations that both sides are using electrical means of communication to their full extent. It is known that the Japanese armies are connected together by a system of field lines, their outposts by telephone and their bases with Chemulpo and Japan by cable. On the day before the battle of the Yalu, the fire of the Japanese howitzer batteries was controlled and directed by telephone, and on the day of the battle during the movement of the XII Division its commander was continuously connected by telephone with the Commanding-General of the Japanese forces. The value of wireless telegraphy to the Japanese Navy in its operations in the China seas, and to the Russians by allowing the commander of a beleaguered place to communicate with his home Government, is too obvious for comment. It seems at the present state of the art that wireless telegraphy will not play as important a part in land communications as the telegraph or telephone until the present methods of its operation have been greatly improved upon.

The part played by the cable in the history of recent years has completely proved that its role is scarcely inferior to the military and naval forces themselves. All the colonial powers of the world have so arranged their means of cable communication that the cables are under their immediate control and touch only the shores of their own possessions or those of countries that are allied to them by treaty and community of interest. The control of the seas, one of the material elements contributing to the power and

prosperity of a nation, is influenced largely by cable communications, and in a war in the future between two naval powers the result will depend largely on coal and cables.

MODERN HIGH SPEED PRINTING TELEGRAPH SYSTEMS.*

BY J. C. BARCLAY.

Machine telegraphy is undoubtedly destined to play, if not a dominant, at least a highly conspicuous part in the telegraphy of the future. For the present, and probably for a long time to come, the Morse system will continue to be the standard system employed in this country. It is doubtful, indeed, if the Morse apparatus—representing as it does the very acme of simplicity—will ever be wholly superseded, but new and improved, as well as more economical methods of working, will, slowly perhaps, but nevertheless surely, limit its field of operations.

The advances made in recent years in the direction of developing and perfecting a printing telegraph system, adapted to meet all the requirements of a modern telegraph service, have been of such a practical and progressive character as to leave no room for doubt that the successful advent of such systems into the domain of commercial telegraphy will soon be, if it is not indeed already, an accomplished fact.

Ever since the birth of telegraphy, the subject of printing telegraph systems has more or less engaged the serious attention of electrical inventors, and as a result of their efforts quite a number of such systems have been devised and put into operation; but until quite recently their usefulness has, with few exceptions, been restricted to stock and market reporting or other enterprises of a more or less private and local character.

For the general telegraphic work of the country these systems are entirely too slow; they can only be successfully operated over limited distances, and their records are, as a rule, made upon a strip of paper which is regarded with anything but favor by the telegraphing public of to-day.

In the elements of weakness above mentioned lie the stumbling blocks to success, but of this the majority of printing-telegraph inventors appear to be entirely unconscious, judging from the way their energies are misdirected in continued efforts to develop and perfect a type of machine for which there is absolutely no demand in the great commercial departments of the telegraphic industry.

Many of the more recent inventions are based upon the principles embodied in the ordinary commercial typewriter, whose peculiar adaptability to the requirements of a telegraph printer was soon recognized, and whose advent into the art may be said to have marked the beginning of the new era of modern high speed type-printing telegraph systems.

It may be said of the majority of printing telegraph contrivances based on the typewriter principle that they are "fearfully and wonderfully made," but a few comparatively simple ones are to be found that can be operated at speeds higher than those attainable by any of the ticker systems, while at the same time making their records in page form instead of upon the objectionable paper tape. The maximum speed at which they can be worked, and the distances over which they can be satisfactorily operated, are, however, so far below the requirements of the present telegraph service, that until they have become more highly developed along the lines indicated, their sphere of usefulness will be limited to enterprises outside the field of commercial telegraphy.

One principal source of weakness in connection with these moderately-fast short-distance machines consists in the character of the signaling currents employed, which, as a rule, lack the necessary quality for overcoming the retarding and attenuating effects of the main line. Very short signaling impulses that differ greatly in strength with occasional changes in direction—as employed by some inventors—is not a current arrangement adapted to long distance transmission; nor is a combination of electrical impulses of one polarity and of uniform strength much better calculated to increase the signaling distance over lines of considerable inductive capacity, the tendency of which is to retard and absorb such impulses.

A much better plan to secure effective signaling is to incorporate into the system a method of reversing or alternating the line currents, and until inventors more fully realize the importance of some such arrangement, their chances for success in the direction of long distance working will be highly problematical.

The superiority of the alternating current method for printing telegraph purposes has already been pretty well demonstrated, and this fact opens up the interesting question as to what particular extent such currents might be utilized with advantage in the working of ordinary telegraph circuits. It is well understood that the successful operation of these circuits is seriously handicapped by certain line-disturbing elements that are more likely to increase than to diminish in magnitude and intensity as the years roll by.

The leakage interference from the ubiquitous trolley lines constitutes, for instance, one of the growing evils that beset the telegraph engineer, while more or less trouble is to be appreherded from the development and extension of high pressure transmission lines with their immense capacity for creating inductive or other disquieting influences. It is possible to exclude the former and to modify the effects of the latter's interference by the use of condensers directly inserted in the main line, which arrangement would also wholly or partly rid the circuit of all ground currents and leakage currents from neighboring wires, as well as minimize the deleterious results arising from defective insulation, variations of resistance, capacity, etc. Such an arrangement, however, would be utterly impracticable with the ordinary battery currents, but as the alternating signaling impulses can be easily transmitted through condensers, a combination of the character mentioned would seem to lend itself in a manner quite feasible to the practical exclusion of most of the disturbing influences to which all telegraph lines are more or less subjected.

Whether or not this principle will ever find a general application in ordinary telegraph working, it is certain that the subject is receiving considerable attention at the hands of telegraph inventors, several of whom have already succeeded in making practical applications of such a character as to suggest possibilities of the utmost importance in this new and promising field of telegraphic development.

Harking back to the subject of printing telegraphs, it may be remarked that no matter what kind of transmitting current may be employed in connection therewith, a satisfactory system at the present time calls for page printing, a high rate of speed, over considerable distances, and some few of the latest inventions pertaining to this particular art take note of these essential requirements.

The most highly developed specimens and best known examples of this modern class of machine are those invented by Murray, Rowland and Buckingham.

In the Murray system the messages are

*Paper presented before Section G, Electric Communication, at the International Electrical Congress held at St. Louis, Mo., September 12-17, 1904.

both transmitted and recorded mechanically through the medium of a typewriter. A perforated paper tape is first prepared by means of a keyboard mechanism, and is then run through a Wheatstone transmitter which automatically, and at a high rate of speed, sends out the signaling currents to the distant receiving station. These currents are utilized, not to actuate the printing mechanism direct as is the case with all other printing telegraph systems, but to reproduce another perforated tape, the particular function of which is to mechanically control the working of a typewriter in a manner analogous to that by which a mechanical piano may be operated by a perforated band of paper. This is a highly novel and ingenious application, since the actual printing is accomplished locally, and without regard to the signaling currents coming over the line; but the use of the perforated tape at both the transmitting and receiving stations introduces an element of delay that is more or less objectionable despite the rapidity with which the signaling currents may be flashed over the main wire.

In Rowland's printing arrangement there is no such objectionable feature, the transmitting apparatus having been designed to work directly into the line, and to operate the receiving mechanism in a manner equally direct. Direct transmission and reception is, in fact, one of the most desirable features in connection with the operation of any telegraph system, but when this is accompanied by a very large increase in the carrying capacity of the wire over which such system is worked, the latter may not unjustly be regarded as one coming well within the range of being an ideal method of working. Such, at least, are the views expressed by the advocates of Professor Rowland's Octuplex System, and these views might be readily accepted if to the other admirable features of this "Telegraphic Wonder of the Age" the great merit of simplicity could only be added.

The system is operated on the multiplex principle, and requires that between certain corresponding parts of the rotating mechanism at each end of the line perfect synchronism be maintained. Success in this direction heretofore has only been practically accomplished over very short distances with transmissions as numerous as those involved in the Rowland printing arrangement. It is claimed, however, that the difficulties previously encountered in the way of maintaining unison over considerable stretches of line have now been fully overcome by the use primarily of an alternating current continually flowing to line, which current not only provides for the necessary synchronizing impulses, but for the signaling impulses as well. The sending of the signals, it may be remarked, is actually accomplished not by supplying the line with current at the moment the signal is being transmitted as in the ordinary telegraphic methods, but by cutting out certain of the alternating-current waves, the arrangement being such that one or more of these signals can be made to consist of a combination of suppressed half-waves, the signals so produced being then automatically translated into printed characters. In this way, and by grouping the waves in a mannner admitting of entirely different and independent signals being sent from four Remington keyboards, each of the four transmitting operators employed can cut out four different wave combinations, and send as many different signals over the line in a single second. Forty words per minute is said to be an ordinary rate of speed for a practiced operator using this system, or, since the system can be duplexed, eight times that number, making 320 words in all, may be sent and printed over a telegraph wire in the course of a minute. This, if practicable under the regular conditions of working, would make the Rowland system the fastest of all printing systems, or, what amounts to the same thing, it would be capable of more fully utilizing the electrical conductivity, or transmitting properties of a wire than any other system of similar character.

That the Rowland machine has been very highly developed on the most modern and approved scientific principles is undoubtedly true, but it remains to be more fully demonstrated that an extremely complex system, necessitating the maintenance of the most perfect synchronism and employing as many impulses as those required for the formation of each of the letters or characters, is one practically adapted to the working of other than circuits of moderate length.

To Mr. C. L. Buckingham belongs the credit of having invented the first really rapid, long-distance, page-printing mechanism that was ever successfully employed for the transaction of ordinary telegraph business. Many years had been spent by the inventor in an endeavor to devise and perfect a printing telegraph machine that could be operated over practically unlimited distances, but it was not until the happy idea was conceived of utilizing the Wheatstone automatic system as a basis that success appeared in sight. Through the medium of the Wheatstone terminal and repeating apparatus, it at once became possible to transmit and receive the necessary signaling pulses over the longest telegraph lines, the pulses in this case differing from those of the Wheatstone or Morse in being quite definite in the number requisite to form the various characters, for each of which six electrical impulses alternating in direction are essential.

The distinguishing features of the invention consist of the perforating apparatus for preparing the slip for transmission, and the printer, which is placed in a local circuit arrangement at the receiving end of the line.

The operation of punching differs from that employed in the Wheatstone in that it involves the use of a typewriting machine, by means of which any one may manufacture the slip without the slightest knowledge on the part of the manipulator as to the particular code employed, and at a rate of speed considerably greater than that possible by the use of the Wheatstone perforator.

The slip thus prepared is then run through the Wheatstone transmitter, which automatically forwards the signals to the distant terminal station where they are received upon a Wheatstone relay and thence repeated into the local-circuit arrangement. In this circuit is a variety of relays and eloctromagnets, which call into action a number of novel and ingenious contrivances of both a mechanical and electrical character. Under the control of the electrical impulses received over the line these devices perform their various functions with a regularity, precision and harmonious working of parts that is simply amazing.

One of these devices is a modified form of "sunflower" or current-distributing apparatus of very peculiar construction. It was especially designed to secure a rapid transmission or switching of certain line pulses through one or other of a series of relays connected to the sunflower. Five of these relays known as "selectors" are employed for the purpose of actuating a corresponding number of electromagnetic "adjusters," which control the movements of the typewheel. Short pulses do not affect the selecting relays, but when the pulses are sufficiently prolonged, the motion of the sunflower or distributor—which is normally one of rotation—becomes temporarily checked or arrested by means of an electromagnetic escapement, thereby permitting any such pulse to actuate the particular relay whose circuit is at that moment completed through contact arms on the sunflower.

At least one of the series of the six line

pulses required to form a character must be prolonged, and the particular relay or number of relays that shall be affected within the time required to transmit the entire series of pulses is determined by the regular order in which such pulses are transmitted to line. If, for instance, the first pulse be a prolonged one, the first in the series of relays with its corresponding "adjuster" will respond, and no other. Similarly, if the second pulse be lengthened, the second only in the group of relays will respond thereto, and so on. One or all of the selector relays may be involved in the operation of bringing any letter or character into the required position for printing, the impression itself being invariably accomplished through the medium of the sixth pulse. This pulse, the last in the series, is always a prolonged one of a certain definite polarity, and is not only utilized for the purpose stated, but also to start the feed mechanism, as well as to operate a dogging device which holds the type-wheel firmly in position while the impression is being made. It contrives, furthermore, to actuate the synchronizer, and thereafter to reset or restore to their normal positions such of the selecting and adjusting instruments as were brought into activity by the one series of line pulses, and to thus put them in a condition of readiness for the next cycle of operations.

The type-wheel is suitably mounted upon a shaft of such construction as to permit the wheel to move axially, or circumferentially, or in both directions simultaneously. Instead of a comparatively large wheel having the entire number of characters on its periphery and rotating all the way round, the inventor employs a small wheel bearing four rings or rows of type which only rotate through a half revolution in either direction. The regulation of the type-wheel is effected through the action of the adjuster magnets whose armature levers are connected with certain impelling or driving devices, some of which impart a rotary, and others a longitudinal motion, or a combination of both movements to the typewheel. The axial or longitudinal movements of the wheel bring any desired ring or row of type into line with the press pad, while the rotary movements shift the different type of a row or ring into the proper position for printing.

It is by such movements, either singly or in combination, that any type of the several rings may be brought to position on the completion of the requisite number of pulses.

The blanks upon which the messages are printed are the regular message forms whose edges have been pasted together so as to give the blanks a tubular shape or appearance. When the printing of a message is about to begin a tube is placed in position beneath the type-wheel by sliding it edgewise upon a brass tube which serves as a support, and in which there is an opening to admit of the necessary operations and impressions taking place. The blank when printed is quickly sliped to one side and a fresh one takes its place, after which the first blank is removed from the support by opening it on the line where its edges are joined, and so on.

(To be continued.)

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCT. 25, 1904.

Electric Railways and Appliances.

772,985. Insulated Rail-Joint. George A. Weber, New York City, assignor to the Weber Rail Joint Manufacturing Company. Filed June 8, 1904

772,987. Contact for Trolleys. Thomas F. Wetton, Newark, O. Filed Feb. 4, 1904.

773,048. Trolley-Wheel. Ray E. Briggs, Chicago, Ill. Filed June 15, 1904.

773,065. Electrical Railway Signal. James L. Dickey, Atlanta, Ga. Filed Aug. 29, 1902.

773,080. Electric Signal for Railways. Wilbur C. Lamphier, Worcester, Mass. Filed June 17, 1903.

773,263. Electric Train-Signal. Ernest M. Quittmeyer, Bridgeport, Conn. Filed Dec 23, 1903.

773,280. Trolley-Harp. Thomas Egan, Muscatine, Ia. assignor of one-half to J. G. Dermedy, same place. Filed April 14, 1904.

773,314. Trolley-Catcher. Charles F. Davy, Mohawk, N. Y. Filed June 20, 1904.

773,334. Trolley-Signal. Charles H. Morse, Cambridge, Mass. Filed Sept. 21, 1903.

773,415. Signaling System for Railways Charles G. Otwell and Ira H. Melvin, Laurel, Del. Filed Feb. 11, 1904.

773,438. Electric Railway. George H. Thomas and Martyn J. Stone, Scranton, Pa. Filed Oct. 14, 1903.

773,459. Trolley. Martin L. Beistle, Ingram, Pa. Filed Aug. 15, 1904.

Electric Lights and Appliances.

772,921. Current-Limiting Switch for Electric Lights. Harry W. Brown, Winchester, Mass., assignor to the General Electric Company. Filed Dec. 3, 1901.

Electrical Machinery and Apparatus.

772,914. Switch. Charles C. Badeau, Schenectady, N.Y., assignor to the General Electric Company. Filed Sept. 16, 1901.

772,923. Time Cut-out for Electric Circuits. Edwin F. Callender, Galesburg, Ill. Filed Dec. 10, 1900.

772,950. Alternating-Current Motor. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 10, 1904.

773,062. Electric Igniter for Gas-Engines. Robert Cooper and John Cooper, Saltsburg, Pa. Filed Feb. 14, 1902.

773,119. Circuit-Breaker. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Filed June 22, 1903.

773,120-125. Electric-Motor System. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Filed Dec. 2 and 4, 1903.

773,121-123. Rotary Mercury Circuit-Breaker. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Filed Dec. 2 and 4, 1903.

773,168. Sparking Plug. Charles F. Splitdorf, New York City, assignor to the Electric Vehicle Company. Filed March 13, 1903.

773,182. Automatic Electric Switch. James I. Ayer Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Filed June 27, 1904.

773,195. Relay. Thomas A. Casey, Jersey City, N. J., assignor to the Manhattan Electrical Supply Company. Filed March 16, 1904.

773,213. Electrical-Controller Attachment. Albert H Mathewson, Thompsonville, Conn. Filed April 7, 1904.

773,369. Electrical Block-Signal. Howard Brooks, Wheaton, Ill., assignor of one-half to J. W. Porter and M. A. Berg, Chicago, Ill. Filed Dec. 21, 1903.

773,398. Apparatus for Regulating Voltage. Maurice Leblanc, Paris, France. Filed Jan. 5, 1903.

Telephones and Telephone Apparatus.

772,927. Apparatus for Through Ringing on Telephone Trunk-Lines. Henry M. Crane, New York City, assignor to the Western Electric Company, Chicago, Ill. Filed Feb. 17, 1902.

772,936. Cut-Out Switch for Telephones. James R. Harris and Charles A. Harris, Trenton, Mo. Filed June 23, 1904.

772,944. Electrical Testing Apparatus. William J. Kyle, Philadelphia, Pa., assignor to the Keystone Telephone Company, same place. Filed Nov. 19, 1902.

773,007. Telephone System. Richard M. Eaton, Philadelphia, Pa. Filed Dec. 31, 1901.

773,187. Telephone Signaling Device. Donald M. Bliss, Brookline, Mass., assignor to the Holtzer-Cabot Electric Company, same place. Filed Sept. 19, 1902.

773,372. Electric Circuit. George A. Campbell, Newton, Mass., assignor to the American Bell Telephone Company. Filed March 5, 1900.

773,506. Multiple Switchboard for Telephone-Exchanges Milo G. Kellogg, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Feb. 28, 1891.

Miscellaneous.

772,959. Medical Battery. Leon W. Pullen, Philadelphia, Pa., assignor to the Wireless Railway Company. Filed Feb. 18, 1904.

772,963. Electric Cigar Lighter. William Roche, Jersey City, N. J. Filed Jan. 29, 1904.

773,024-025. Signaling. John Millar, Kearney, N. J Filed Oct. 22, 1902.

773,039. Signaling System. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Filed Oct. 22, 1902.

773,040. Block-Signal System. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Filed Dec. 7, 1903.

773,069. Apparatus for Utilizing Electrical Oscillations for Signaling Purposes. Clarence E. Freeman, Chicago, Ill. Filed Jan. 14, 1901.

773,122-124. Electric Hammer. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Filed Dec. 2, 1903; Dec. 4, 1903.

773,166. Electric Signal System Howell W. Souder, Tamaqua, and John Early, Lansford, Pa. Filed Dec. 7, 1903

773,171. Method of Receiving Eelectrical Impulses. Daniel W. Troy, New York City. Filed April 8, 1904.

773,198. Telegraph System Albert C. Crehorne, Yonkers N. Y. Filed Aug. 12, 1903.

773,246. Magnetic Separator. John W. Carnoohan, Silver Creek, N. Y., assignor of one-half to Albert B. Chapman, Silver Creek, N. Y. Filed Nov. 27, 1903.

773,249. Clamp for Battery Electrodes. Eben G. Dodge, Orange, N. J., assignor to James W. Gladstone, West Orange, N. J. Filed June 27, 1904.

773,326. Electrical Signaling Apparatus. Charles A Junken and William B. Tredwell, Hampton, Va., said Tredwell assignor, by mesne assignments, to William H. Boyenton, same place. Filed Feb. 17, 1904.

773,331. Electric Battery. Charles F. Mackey, Philadelphia, Pa., assignor of two thirds to William H. Tomer and Harry N. Carter, same place. Filed Dec. 11, 1903.

773,340. Telegraphic Receiving System by Means of Hertzian Waves. Octave Rochefort, Paris, France, assignor of one-half to the La Societe Anonyne d' Electricite et d'Automobiles Mors, Paris, France. Filed Aug. 26, 1903.

773,374. Instrument for the Teaching and Practice of Telegraphy. Charles E. Chinnock, Brooklyn, N. Y. Filed Jan. 20, 1902.

773,407. Apparatus for the Electrical Treatment of Air. John E. Mitchell and Dennis Parks, St. Louis, Mo. Filed July 9, 1904.

Reissue.

12,281. Electric Motor. Albert B. Holson, Chicago, Ill. assignor, by mesne assignments, to the Holson Motor Patents Company, Limited, Grand Rapids, Mich Filed May 31, 1904. Original No. 701,341, dated June 3, 1902.

THE TELEPHONE WORLD.

Pushing Work of Independent Long Distance Line.

It has been announced that the construction gang of the Independent Telephone Company would reach Ottawa, Kan., November 10, with a Kansas City toll line to connect with the Home exchange in Kansas City. The line will be pushed from Ottawa south into the oil and gas fields as rapidly as possible. The plan is eventually to join all Independent exchanges.

New 'Phone Trunk Line.

The Consolidated Telephone Companies of Pennsylvania, with a system of exchanges extending from McKeesport to Norristown, have entered into negotiations for the sale of their properties to the United States Telephone Company, whose plan is to establish a trunk line from New York via Philadelphia to Chicago.

Under the plan the United States Company is to come into possession of the Independent exchanges at Norristown, Reading, Allentown, Scranton, Wilkes-Barre, Mauch Chunk, Harrisburg, Altoona and McKeesport, all having connection with the Keystone of Philadelphia, and also with the Independent Knickerbocker of New York, by way of the cross Jersey lines.

The private branch exchanges recently installed in some of the larger business establishments in Chattanooga, Tenn., by the local telephone exchange have met with such success that the idea is being adopted in many other business houses and branch exchanges are being installed. The local telephone exchange under its new manager, Mr. Webb, has made rapid improvements in its service. Within the last 60 days more than 300 'phones have been installed with a large per cent. of these representing new territory not formerly covered by this exchange. A great many telephones have been placed for new comers in the city, proving the material growth of Chattanooga.

Work has begun on the extension of the telephone line from Cookes Point to Rita, Tex. This gives Caldwell connection with every section of Burleson County. Rita is of importance now, as it is the center of the oil field in the northern part of the county, and startling news is expected from there at any time.

At a recent meeting of the Williamsburg, Mass., Telephone Company the following officers were elected: A. S. Hills, president; E. W. Goodhue, vice-president; Stephen Jorgensen, secretary and treasurer. Work on the construction of the plant will be started at once.

About 35 farmers southwest of Gaylord, Mich., have for some time been talking of a telephone line to Gaylord, and things have so far progressed that it is now in sight. It will connect with a line already built seven miles out from Alba, and from there will extend into Gaylord.

The Perrysville, Pa., Telephone Company has been organized for the purpose of operating a telephone line between Genesee, N, Y., and West Bingham, Pa.

Work on the Consolidated Telephone Company's trunk line has been completed as far as Womelsdorf, Pa., and communication with Lebanon and the west has been effected.

Frontier Telephone Company Officers.

The recently elected board of directors of the Frontier Telephone Company of Buffalo, N. Y., met recently, and elected these officers:

President, Henry H. Persons, who has been first vice-president and general manager of the company for the last year.

First vice-president, E. C. Lufkin.

Second vice-president, S. E. Wayland, of Scranton.

Treasurer, Fred L. Mesmer, now auditor of the company.

Secretary, John Jolly, the present contract agent.

To Maintain an Independent Line.

A meeting of the stockholders of the Maine & Union, N. Y., Telephone Company, was held lately at the office of A. R. Humphrey, to consider a proposition made by the Bell Telephone Company relative to making connections with that company. Representatives of the Bell Company were present and explained the proposed consolidation. After giving the matter careful consideration, it was voted not to accept the proposition. It was decided to continue the work of procuring subscribers in Union and vicinity.

The American Construction & Trading Company, of Elyria, O., has purchased a half interest in the Interstate Telephone Company of Little Falls, N.Y., for the purpose of making a link in the cross-State long distance Independent telephone service. Irving H. Griswold, of Albany, represents the purchasers. The Interstate controls 2,000 telephones in Herkimer and Montgomery Counties. It is understood that the Bell long-distance was also negotiating for the purchase of the Interstate.

Work was commenced lately on the construction of the lines of the Cecil Farmers' Telephone Company. The line will be run from Rising Sun to Fort Deposit, Md., and secure connections there with the Maryland Telephone Company for long-distance service. It is the intention to develop the service throughout Cecil County as rapidly as possible. The company was granted a charter by the last session of the Legislature at the instance of the Cecil Farmers' Club, whose members constitute the board of directors of the concern. The exchange will be located in Rising Sun.

An ordinance has passed second reading before the Lower Merion, Pa., commissioners, granting the Keystone Telephone Company rights of way through the township. An amendment provides that the telephone company must construct at least four miles, or from the city line at Overbrook to Ardmore, within two years.

The city council of Wymore, Neb., has granted a franchise to the Gage County Independent Telephone Company, and it is understood work on its lines will be commenced at once.

The Hartwell, Ga., telephone exchange has been purchased by F. P. Linder from L. M. Felton. Mr. Linder has purchased a large lot of supplies and will greatly improve the exchange.

Parisian Telephone Users Hope for Better Service.

The Association of Telephone Subscribers, recently organized to protect their rights against a rather too haughty administration, held a meeting recently at which the president, the Marquis de Montebello, announced highly successful results of the campaign inaugurated.

The administration had promised not to suspend subscribers without good reason hereafter, and also to increase the number of operators.

Denton, Tex., in addition to being supplied with good telegraph facilities, has two fine telephone exchanges. The first telephone erected in that city was meagerly patronized, there being only a small number of 'phones in working order for a long time. Now, however, there is a vast difference in the condition of things generally. The People's Home Telephone Company only recently completed the installation of its plant there at a large outlay of money and labor. The plant is one of the most up-to-date in Texas.

The Cumberland Telephone Company has put its rates so high and its service is so unsatisfactory that there is a move on foot in Henderson, Tenn., to organize a home company, which it is hoped to have in operation by the first of the year.

The Amsterdam, N. Y., Automatic Telephone Company is completely rebuilding its plant. There will be several different classes of service, such as measured service, four-party, selective and individual service.

The property of the Huntsville, Guntersville & Gadsden, Ala., Telephone Company, has been sold at auction by decree of the chancery court, and the creditors bid it in. The purchasers own the principal stock of the Gurley and New Hope telephone and will merge the systems.

The Farmington. Conn., Telephone Company has declared a semi-annual dividend of 3 per cent.

The Kirtland Telephone Company, of Lake County, O., has increased its capital stock from $25,000 to $50,000.

A 10-mile telephone line will be built from Egg Harbor to Green Bank, N. J.

Telephone Incorporations.

The Botkins Telephone Company, Botkins, O. Capital stock, $10,000.

The Sweet Springs Telephone Company, Sweet Springs, Mo. Capital stock, $20,000. Incorporators; J. H. Dickson, R. Sam Hays, Charles K. Smith and others.

The State Mutual Telephone Company. Washington, D. C. Capital stock, $50,000. Incorporators: A. D. Weller, T. J. Gray, T. B. Lee, Frank R. Hollingshead, E. M. Root, J. Dan Blackistone and A. J. Bette.

The MacDougal Telephone Company, MacDougall, N. Y. Capital stock, $5,000. Incorporators: A. Baldridge, R. C. Allen, A. Baldridge. Jr, all of MacDougal.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aberdeen, Pa.—This town is to be bonded for $3,000 for the purpose of installing an electric lighting plant.

Beach City, O.—This city is to have an electric lighting plant soon.

Canon City, Col.—The Colorado Electric Power Company has arranged with the Arkansas Valley Electric Company of Florence to furnish it power for lighting and for all other purposes for which electricity is used in the city of Florence, and will begin at once the construction of a line of high voltage for the transmission of the current.

Columbia, Ky.—This town is soon to have an electric lighting system.

Danville, Ky.—Frank T. Snyder, of St. Louis, has secured a franchise from the city council to erect an electric light and power plant.

Dardanelle, Ark.—Hon. H. M. Jacoway, of this city, reports that the New York capitalists who recently purchased the Dardanelle cotton mill will make application for an electric light franchise.

Graceville, Fla.—This town is to have a waterworks and electric light plant in the near future.

Holyoke, Mass.—At the last meeting of the city council a movement providing for a loan order of $30,000 to be used for reconstructing and enlarging the electric light station was passed.

Jefferson City, Mo.—A special election to vote on the proposition of granting an electric light and gas franchise, will be held November 15.

Lenox, Ia.—The Lenox Electric Light & Power Company has been granted a local franchise.

Milwaukee, Wis.—A. F. Wardlow, a lighting expert, declares that he has obtained data enough to warrant the assertion that a Milwaukee municipal light plant and site will not cost to exceed $200,000. The cost of installing conduits for the wires is still to be included in his figures.

Novinger, Mo.—The proposition to erect an electric lighting plant here was carried at the special election. Work on the plant will be started at once.

Oklahoma, Okla.—The Territorial Engineering Company has been incorporated with a capital of $25,000, to construct and operate street railways and electric light and gas plants, with principal offices in this city. G. W. Burke, F. H. Peckham and M. L. Cunningham are interested.

Peoria, Ill.—The city council has received petitions asking for additional electric lights at street corners of the city.

Princeville, Ill.—The contract has been let for installing an electric light plant, which will be built and owned by the city.

St. Joseph, Mo.—At the meeting of the council the ordinance appropriating $75,000 for a new electric light plant was passed.

Stoughton, Wis.—A special election will be held here to vote on the proposition to issue bonds for the establishment of a municipal electric lighting system.

Sumner, Ia.—Hartig & Hellier, of Minneapolis, have been granted a franchise for an electric lighting and power plant.

Tacoma, Wash.—Mayor Wright has been approached with a proposition from local parties to install a complete 5,000 hp. electrical plant for the benefit of the city at a cost of $500,000.

Vacaville, Cal.—The citizens will soon vote on two propositions to issue bonds; $25,000 for a sewer system and $40,000 for the purchase of the present water and electric light system or the construction of an entire new system.

Wichita, Kan.—A franchise was lately granted to the Citizens' Electric Light, Heat & Power Company to install a new electric lighting and heating plant. Mr. Landis, who has the management of the new company, said that the plant would be in operation before many months have elapsed.

Winona, Minn.—H. M. Lamberton has secured a 25-year franchise from the city for the establishment of an electric lighting plant.

STREET RAILWAYS.

Allendale, Mich.—The people here feel that they are very much in need of an electric railway.

Chicago, Ill.—A road now building between Benton Harbor and Kalamazoo, Mich., when completed in 1905, will provide trolley transportation from this city to New York and Boston. The last gap in the trunk line is being constructed from Kalamazoo, which will make direct line between Benton Harbor and New York. The spread of the Michigan lines is due to a fight between the Pere Marquette road and the Graham & Morton Steamship Company. The line to New York will carry freight and passengers.

Findlay, O.—It is claimed that the electric railway between here and Marion via Mt. Blanchard, Forest and Marseilles will be constructed.

Fort Worth, Tex.—The Northern Texas Traction Company is now engaged in making improvements, the aggregate cost of which will reach more than $50,000. This does not embrace work in contemplation, but work and betterments actually uner way.

Geneva, O.—It is understood that work on the line of the Geneva Electric Company will start next spring.

Grand Haven, Mich.—The Riverside Electric Railway Company has been granted a franchise to run its road through the county.

Hannibal, Mo.—A party composed of A. E. Archenbach, of South Bend, Ind., L. T. Eastman, Fred Modek and J. R. Hamilton, have finished several miles of survey for an electric line betwen this city and Quincy.

Holland, Tex.—An extension is rumored of the Belton-Temple Interurban Electric Road to Salado, Holland, Vilos, Ragin and Seaton. which would make a circuit of about 50 miles. The people along the route, it is said, would heartily welcome the coming of the road.

Iola, Kan.—E. V. Crouch, president of the Kansas Southern Electric Railway Company, has announced that a new line would be built from here to Chanute.

Lexington, Ky.—President Y. Alexander is the promoter of a company to build an electric line from this city to the Blue Grass towns.

Litchfield, Ill.—The Litchfield Traction Company has been incorporated with a capital of $5,000, with M. J. Buscher, G. L. Settlemire and others as the directors.

Monessen, Pa.—The Jeannette, West Newton & Monongahela Valley Street Railway Company has been organized. It is the intention to erect a trolley line from Webster to Jeannette by way of West Newton. The officers are James C. Cribbs, president; W. H. Van Valin, vice-president; W. F. Euwer, treasurer, and A. T. Smith, secretary. George Baker, of the New England Construction Company of New York, has been appointed chief engineer.

Monroe, La.—Through the efforts of Mayor A. A. Forsythe this city will soon have an electric street car system, owned and operated by the municipality.

Richmond, Va.—Gaines Mill and the surrounding tract near Cold Harbor, in Hanover County, the famous scene of one of the civil war's most bloody encounters, has become the property of Joseph Woodson, of this city. At present a long drive or walk is the only way to reach the place, but there are indications that in a short time an electric line will be run from here to Cold Harbor.

Rochester, N. Y.—The proposition to construct a trolley road from this city to the southern tier counties, is apparently rapidly taking definite form. E. E. Shutt, of this city, is one of the promoters in the enterprise.

San Francisco, Cal.—The electrical engineer of the Southern Pacific Company has submitted to General Manager H. C. Markham plans to convert the ferry steam roads and the South Pacific Coast Narrow Gauge as far south as San Jose, into electric roads, together with estimates of cost for construction and the cost of obtaining electric power from the Bay Counties Power and the Standard Electric Companies, controlled by John Martin, Eugene de Sabla and their associates.

Wooster, O.—The Baltimore & Ohio will make an electric line out of a portion of the Cleveland, Wooster & Muskingum Valley Road.

POWER PLANTS.

Lancaster, Pa.—The work of building a power plant for the Lancaster & Piqua Trolley Road will be started this week.

Memphis, Tenn.—At a recent city council meeting the water commission was considering the advisability of establishing a power plant for generating electricity with which to conduct the pumps. The matter is now under consideration.

BIDS WANTED.

Rochester, N. Y.—The board of contract is advertising for bids for buying meters for testing the electric light.

Saginaw, Mich.—The committee on public grounds and buildings of the board of supervisors of this city will receive bids for the re wiring for electric lighting of the Saginaw County Court House. Address F. P. Whaley, county clerk.

Winthrop, Minn.—The council of this village advertises that sealed proposals for $7,000 electric light and waterworks bonds will be received.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, $13\frac{3}{8}$@$13\frac{1}{2}$c.; Lake $13\frac{1}{2}$@$13\frac{5}{8}$c.; casting, $13\frac{1}{8}$@$13\frac{1}{4}$c.

There is a report to the effect that directors of the Chicago Edison Company are contemplating another issue of new stock.

In consequence of the general adoption of the telautograph by the principal trust companies, the Gray National Telautograph stock is being bought up by strong banking interests.

An electric locomotive built by the General Electric Company for the New York Central terminal service in New York City showed a trial speed at Schenectady of 55 to 60 miles an hour.

General Manager Stuart, of the Erie Railroad Company, has invited estimates from the various telephone companies for installing a complete telephone system between Cleveland and Jersey City.

President John H. Michener, of the Bank of North America, Philadelphia, has become a member of the Bondholders' Protective Committee of the Philadelphia & Lehigh Valley Traction Company.

The annual report of the Springfield (Mass.) Street Railway Company for the year ended September 30, shows a deficit after dividends and charges of $33,018. The company pays 8 per cent. dividends.

The directors of the American District Telegraph Company declared a dividend of 1 per cent. on the outstanding stock of the company, to be paid on November 15. Books close November 5 and reopen November 16.

The Washington (D. C.) Railway & Electric Company has declared a dividend of $2\frac{1}{2}$ per cent. on its preferred stock for the six months ending December 1, 1904, payable December 1 by the United States Mortgage & Trust Company to holders of voting trust certificates of record November 21.

Justice Spencer has appointed Walter P. Butler receiver of the Ballston (N. Y.) Terminal Railroad Company, to sell the road. The proceeds will be applied on liens in the following order: Adirondack Trust Company of Saratoga Springs, $11,000; Metropolitan Trust Company of New York, $250,000; Citizen's Savings & Trust Company of Cleveland, Ohio, $100,000.

Rumors have been current in Philadelphia that the Electric Company of America will increase its dividend rate from a 6 per cent. to an 8 per cent. basis in January. Concerning this and other rumors a high official of the company said: "The question of an increase in dividend has not yet been given serious consideration by the directors of the company. I think, however, that 6 per cent., which we are now paying, is a very satisfactory return in these days."

At a recent meeting of the Board of directors of the Public Service Corporation, held in Newark, N. J., an issue of $7,250,000 of 5 per cent. five-year collateral trust bonds of the concern was authorized. They are to be secured by the deposit of approximately $11,500,000 of the bonds of the subsidiary corporations and the entire issue was sold to Robert Winthop & Co., bankers, of New York. By this means the Public Service Corporation, which controls all the trolley, gas and electric power and light systems in the northern part of New Jersey, has provided for all its financial needs for extensions and improvements until 1906. All the plants are to be enlarged.

ELEOTRIOAL STOOK QUOTATIONS.

Name.	Closing price Nov. 1.
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	162
Metropolitan Street Railway	121
Metropolitan Securities	$81\frac{1}{4}$
Ninth Avenue	197
Third Avenue	132
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	66
Public Service Corporation (New Jersey)	104
Philadelphia.	
Consolidated Traction of New Jersey	75
Philadelphia Traction	98
Union Traction	$56\frac{3}{4}$
Boston.	
Boston Elevated	$154\frac{1}{8}$
Massachusetts Electric Companies, com	$13\frac{3}{4}$
do. do. do. pref.	$55\frac{3}{4}$
West End Street, com	$91\frac{1}{8}$
do. do. do. pref.	$111\frac{1}{4}$
Chicago.	
City Railway	185
North Chicago	71
Union Traction, com	$9\frac{1}{2}$
do. do. pref.	39
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	14
do. pref.	$60\frac{1}{2}$
Electric Boat, com	40
do. do. pref.	72
Electric Lead Reduction	$\frac{1}{2}$
Electric Vehicle, com	15
do. do. pref.	22
Westinghouse, com	$169\frac{1}{2}$
do. pref.	190
General Electric	174
Boston.	
Edison Electric Illuminating	250
General Electric	174
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	160
National Carbon, com	37
do. do. pref.	110
Philadelphia.	
Electric Company of America	$9\frac{7}{8}$
Electric Storage Battery, com	74
do. do. do. pref.	74
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	$143\frac{1}{2}$
Western Telephone Company	19
New England Telephone Company	$133\frac{1}{2}$
New York.	
American Telegraph & Cable Company	92
Commercial Cable Company	210
Mexican Telephone Company	$1\frac{1}{2}$
New York & New Jersey Telephone Company	$158\frac{1}{4}$
Postal Telegraph Cable Company	..
Western Union Telegraph Company	$91\frac{1}{2}$
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	40
Consolidated Car Heating	64
Standard Underground Cable	200

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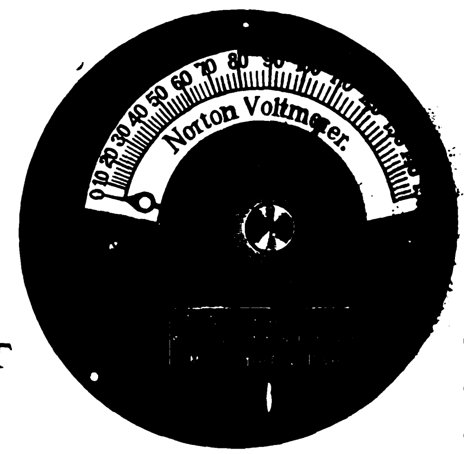

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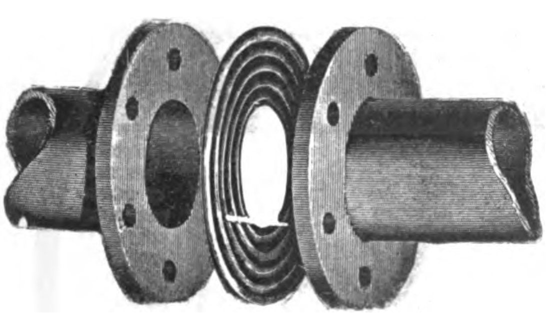

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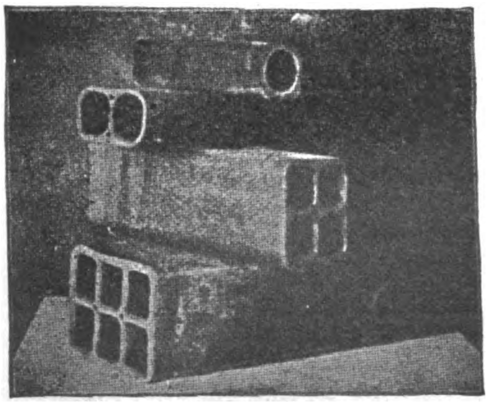

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ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

The Copper Situation.

In a recent issue of the "Wall Street Summary" there appeared an excellent article on the strong position of copper, referring especially to the urgent foreign and domestic demand for the metal.

The market price of copper is now about 14 cents a pound, whereas three years ago it was selling at approximately 18 cents. In spite of the fact that it can now be bought for three or four cents a pound less, the market position of copper is regarded by many authorities as being much stronger than it was then, as the metal that is being bought is going into the hands of actual consumers, there being little or no speculative buying.

The demand for the metal in this country is attributed in part by the abovementioned paper to a change of motive power from steam to electricity on many of the railroads in this vicinity. Referring to the foreign demand the "Summary" says:

"The export demand for the metal is in almost unprecedented volume, amounting to 202,503 tons for the first ten months of the year, which is far above the total export movement of any year in the past. The demand comes chiefly from Germany and France and is stimulated to no small degree by the Russo-Japanese war, France and Germany manufacturing large quantities of war supplies for the beligerent nations. The English demand has not been much of a factor up to this time in the local copper situation. There has been a decided increase, however, in the shipments to China and Japan, although previously the latter country has usually produced enough copper for its own consumption."

There is little doubt but what the demand for copper throughout the civilized world will increase rather than diminish. That such is the case may be inferred from the fact that during the past year the Western Union Telegraph Company alone has used approximately 15,000,000 pounds in constructing new lines. Furthermore, electrical undertakings, such as power stations, telephone systems and trolley roads are constantly being planned, which require copper in one form or another, and so great may the demand for the metal become that in the near future it may necessitate the opening of copper mines that have not been in operation for years.

* * *

Exit of the Locomotive on Long Island.

The Long Island Railroad Company has decided to use electricity in place of steam, and the transformation of the system will be accomplished in time to meet the the rush of summer travel.

Perhaps the most disagreeable features of railroad travel are the dust and fine cinders which enter the car when it is in rapid motion. The contrast between the steam and electric road in this respect is so marked that it is hardly necessary to touch upon this point.

The question arising in a technical sense is worthy of the closest consideration. It relates to the relative costs of limited lines when operated by steam and electricity. It is an old problem, yet one that could not be solved without the data of continued experiments, and for that reason practical progress has seemed unusually slow. Even now, in referring to some cases where the change from steam to electricity has been made, the results are so doubtful, in fact so unsatisfactory, that if these installations and tests were made the basis for further construction, radical changes would be

required to meet the new conditions imposed by practice.

The exit of the locomotive on Long Island marks a new era in the history of electric railroading. It means the extension of a road whose operation will be watched with the greatest interest by engineers at home and abroad. The day seems to be rapidly approaching which will usher in revolutionary methods in general railroading. Failures in specific cases are not necessarily indications of ineradicable faults. They are, in fact, object lessons by which railroad engineers in the end gain their best experiences. The fact that the New Haven road is removing its electric section and going back to steam is no criterion of the inefficacy of electricity. To keen minds it serves to teach the necessity of knowing the conditions of travel beforehand, and when failure results, as in the case specified, it must be attributed to causes lying deeper down than those apparent at first glance. However auspiciously a new road or new system opens for service, the fundamental fact to be borne in mind is this—that passengers and freight must pay expenses. Opening a road where traffic is light, with the expectation of having it rapidly increase, is sometimes a deathblow to its success. For this reason such changes as those recorded above must be made with circumspection, and it is only by combining the two ideas, of extended utility with a demand already in existence, that a great electric enterprise like that promulgated by the Long Island Railroad Company can hope to succeed.

* * *

Odor in the Subway. The subterranean artery of travel recently opened to the public in this city has been the subject of curious criticism. Many possessed of a streak of superstition anticipate collisions in spite of the remarkably efficient protective devices employed. Others will not ride for fear of ruining their eyes. And finally, a great complaint has arisen regarding the odor in the subway.

William Barclay Parsons, chief engineer of the Rapid Transit Commission, in speaking of this peculiar smell states:

"The odor to which you refer is inseparable from a work of this kind. It is the same odor which you will notice in a machine shop, and is caused by the oil and machinery, plus the heat of the motors. The smell in this road, however, is much less noticeable than it is in the Boston road, for the reason that the cars move more rapidly, creating draughts, drawing fresh air into the tunnel at the many stations and places where ventilation has been provided for."

It is very likely that when the strong winds of winter find their way into the subway, sufficent purification will result to remove this rather unpleasant taint.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

On November 1 and 2, when the New York subway was in active operation, the receipts on the Manhattan Elevated were about $3,000 per day greater than last year.

The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held in New York City on December 7, at the rooms of the New York Board of Fire Underwriters.

By the employment of radium Lord Rayleigh's son, Mr. Richard Strutt, a special cable dispatch to the New York "Herald" says, has constructed a clock that may go for two thousand years without winding.

The annual meeting of the American Society of Mechanical Engineers will be held in New York City, December 6 to 9, inclusive. The headquarters of the society will be at the Society House, 12 West 31st street.

The last locomotives on the elevated system in Brooklyn, N. Y., have gone out of commission. All the lines are now operated by electricity and the old locomotives are to be sold.

A new system of electric baths for the cure of rheumatism, gout, etc., is being introduced into England from the Continent, according to the "Electrician," London. The bath itself is of impregnated wood and is filled with a fluid consisting of a solution of extracts of barks and herbs and a certain percentage of tannic acid; the latter is, it is claimed, eminently adapted for dissipating uric acid deposits which settle in the tissues and joints. The solution is used at temperatures ranging from 90 deg. F. to 105 deg. F., and the maximum duration of a bath is half-an-hour. Metal strips run along both sides of the bath, and are connected to the two terminals of an electric supply. Ten carbon electrodes, in the form of large rectangular plates, hang down into the bath at either side. They are electrically connected to the metal strips by brass supports. The voltage across the terminal strips may be regulated by a rheostat, and is usually about 30 volts. The current—about 2 to 3 amperes—flows from one set of electrodes to the other set, and it may be localized or varied in strength by suitable fixture of the electrodes. A switch is also provided for changing the direction of the current.

The World's Fair judges have awarded the only gold medal for rail joint products to the Continuous Rail Joint Company. The exhibit consisted of rail joints, step joints and insulated and electric bonding joints, which are extensively used on steam and electric railroads.

Mr. William Marconi sailed for Liverpool November 5 on the steamship Campania. He came here three months ago to visit the new station at Glace Bay, and install there certain new high power instruments which give better radiation surface for the electric waves. He goes to England to make the same changes at the Cornwall station and will return to the United States in December. Then, he believes, he can demonstrate that the distance, 3,500 miles, is no bar to a successful working of his instruments.

Electricity is soon to be introduced upon the farms throughout the rural districts of La Salle, Ill.

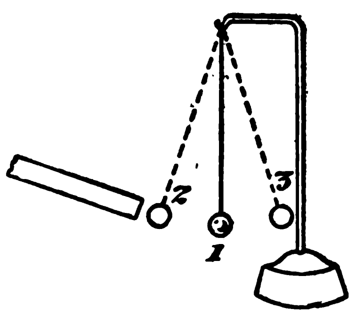
The wireless telegraphy experiments which a detachment of the Telegraph Battalion of the Royal Engineers in England, have been conducting in Carnarvonshire have just been concluded, says the "Electrical Engineer," London. The system used was that devised by Sir Oliver Lodge and Dr. Alexander Muirhead, and the object was to test the practicability of communicating by this system between fairly distant points in spite of intervening mountain masses broken by passes and containing metallic minerals. The stations were about 20 miles apart, and separated by the lofty and rugged Carnarvonshire range. That the waves passed from station to station was soon ascertained, and the chief problem to be solved was the proper adjustment of the instruments. It is stated that the results have been successful, and that a good deal of important information has been gained.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

STATIC ELECTRICITY.

Two Kinds of Electricity.—There are two kinds of electricity, called positive and negative, according to the following experiments: Take a glass rod and excite a charge on its surface by friction with a silk handkerchief. Bring the end of the rod near a pith ball mounted on an insulating support and hanging from a delicate silk thread, as shown in the illus-



Successive Positions of Pith Ball Affected by Charged Rod.

tration. On bringing the charged glass rod near the pith ball, it will be attracted, but on touching the rod will be instantly repelled, assuming the position marked 3. The process may be repeated with a rod of hard rubber on which a charge has been excited by means of a woolen rag. On bringing the hard rubber rod near the pith ball it will he attracted and repelled in exactly the same manner. The positions assumed by the pith ball are relatively 1, 2 and 3 with either rod. The fact to be observed, particularly in the course of such an experiment, is that the pith ball though showing every sign of marked repulsion to the charged glass rod in the first case, instantly flies to the charged hard rubber rod in the second case. And if the experiment is repeated with the glass rod it will be seen that the pith ball strongly repelled from the hard rubber rod will now be attracted by the excited glass rod. The results can be tabulated as below:

I—Glass rod, pith ball attracted, then repelled.

II—Rubber rod, pith ball attracted, then repelled.

III—Glass rod, pith ball attracted, then repelled.

IV—Rubber rod, pith ball attracted, then repelled.

In other words, it is evident, that the electricity in the pith ball, comunicated to it in the first place by the glass rod, causes repulsion, and that the same electricity in the pith ball causes it to be attracted by the rubber rod, though subsequently repelled. And in this manner the operation can be kept up, showing that what the glass rod repels the rubber rod attracts, and vice versa.

The explanation lies in the assumption of two kinds of electricity, called positive and negative, produced by the glass and rubber rods respectively.

When the glass is rubbed with silk, positive electricity is developed on the glass. When the rubber rod is rubbed with flannel, negative electricity is developed on the rod. Bringing the glass rod near the pith ball, causes the pith ball to be attracted, it touches the glass rod and is repelled. The repulsion occurs because it has taken up some of the electricity of the glass rod, which is positive.

The negatively charged rubber rod is brought near, and the pith ball is attracted. This occurs because the pith ball and the rubber rod hold different kinds of electricity, or present different phases of electrical energy. After the pith ball touches the rubber rod and has had some of the negative electricity transmitted to it, it is repelled. The entire process is due to the operation of two simple laws as follows:

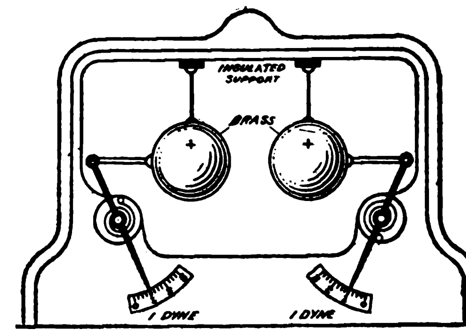
Law I.—Unlike charges attract each other.

Law II.—Like charges repel each other.

When the pith ball touches the glass rod, the positive on both glass and ball causes repulsion. The negative on the rubber can then attract, but when contact occurs also repels. Thus the various positions of the pith ball, 1, 2 and 3, are adequately explained after contact takes place, and when a body charged with an opposite kind of electricity is brought near the pith ball.

This represents the explanation which will hold in all cases where two charges of electricity can affect each other. The character of these charges must be determined, and then a rational conclusion drawn, based upon the two laws as stated. Before a further advance is made in the study of this subject it is necessary to arrive at some conclusion regarding what may be called a unit charge of electricity.

What is a Unit Charge?—To measure static electricity correctly, a simple experiment can be tried or imagined in the following manner: Two spheres of 1 centimeter radius are placed 1 centimeter away from each other. Each sphere is charged with positive electricity, so as to impart to each exactly the same quantity. If the condition is imposed that the spheres each possess an equal charge of electricity, then, when they repel each other with the force of *one dyne*, each sphere possesses a *unit* charge of electricity. To complete the idea it is necessary to define a dyne.



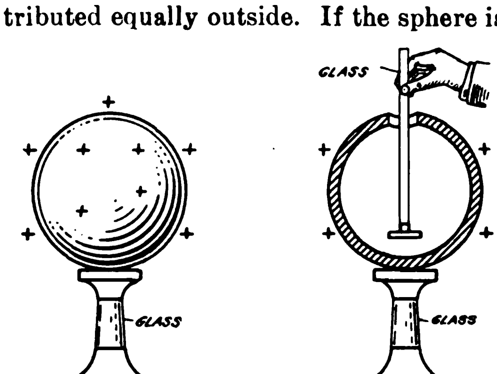
Interpreting a Unit Charge Electromechanically.

Definition of a Dyne.—A dyne is the amount of force required to impart to a gramme the velocity of 1 centimeter per second. It is the same as though the amount of force were measured that is required to move a weight of 1 pound 1 foot per second, only the force in the case of a dyne is much smaller, and is the result of the adoption of the C.G.S. system as the basis for all units.

A unit of electricity, commonly called a unit quantity or unit charge, is named a coulomb in honor of a distinguished investigator of that name. It is defined as that quantity of electricity on the surface of a sphere of 1 cm. radius, which will repel a similar and equal quantity on a sphere of 1 cm. radius at a distance of 1 centimeter with the force of 1 dyne.

The advantage of basing the unit charge, upon the development of a certain amount of mechanical force is found not only in the fact that the system of units employed call for it, but a definite idea is obtained of the amount of electricity, the distance between reacting charges, and the distribution of these charges required to produce a given force.

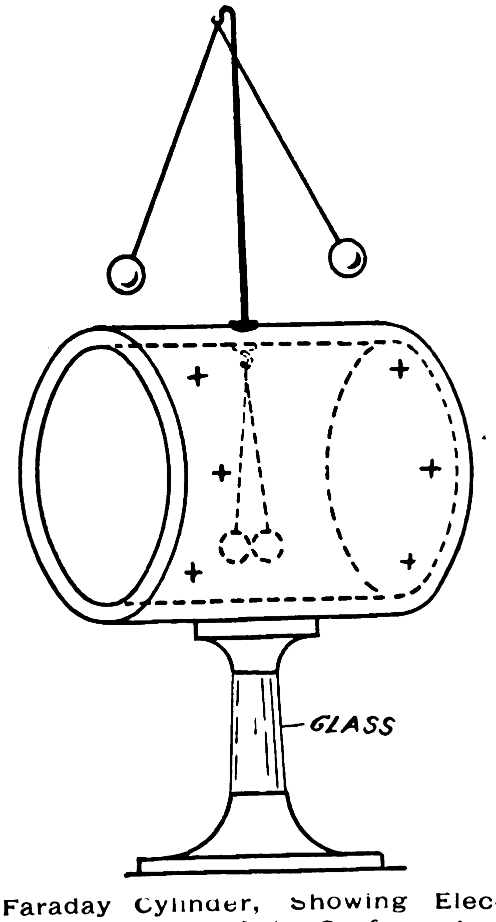
Static Charges Outside of Bodies.—If a sphere is charged with electricity an examination of it will show the charge distributed equally outside. If the sphere is



Solid and Hollow Spheres, Showing Charge on Outside.

hollow, an examination of it when charged, will disclose the same state of affairs, namely, no electricity inside the sphere, the charge being entirely outside. Michael Faraday made note of this fact,

and experimented with what is called a Faraday cylinder for the purpose of illustrating this idea. It will be seen that when the cylinder is charged the pith balls inside show no sign of repulsion, but the pith balls outside violently repel each other. This is due to the presence of electricity only on the outside of the cylinder; were there any inside it would give evidence of its existence, by causing repulsion between the inner pith balls, but as this is not so, the opposite conclusion is inevitable.



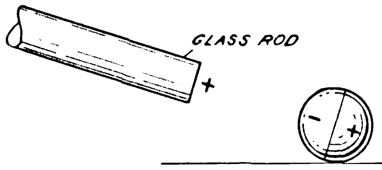
Faraday Cylinder, Showing Electricity only on Outer Surface when Charged.

A network of wires forming a cage would therefore be a great protection against heavy charges of electricity. If a sort of electric cage armor of this description were constructed, enormous charges of electricity could be directed at it without producing the slightest effect upon those within. In large cities with modern steel frame buildings considerable protection is afforded from this source alone against lightning. It also serves as an excellent ground connection during electric storms.

Electrostatic Induction. A keen mind will not be contented with the statement made regarding a charged rod and a pith ball. The inquiry which will arise is this: Why does the pith ball in the first place move toward the charged glass rod? It is to be remembered that the pith ball was perfectly neutral in the first experiment, yet it was immediately affected by the presence of a charge in its neighborhood. How can a charged body affect a neutral body? Why should a pith ball absolutely devoid of any traces of electricity be attracted by a charge of electricity? The answer is as follows: The charged body affects the condition of the pith ball and develops in it both positive and negative electricity. From this fact a general principle can be stated—that induction occurs between a charged body and a neutral body across the empty space between them.

In some remarkable way an influence is promulgated from every electric charge in such a manner that all bodies far and near become possessed of two kinds of electricity.

By giving to this the name of electrostatic induction it must not be understood that the phenomenon is explained. This is not so, it is merely stated and such facts as can be deduced from this experiment are employed for the purpose of investigating other results, the causes of which would otherwise be a matter of great doubt.

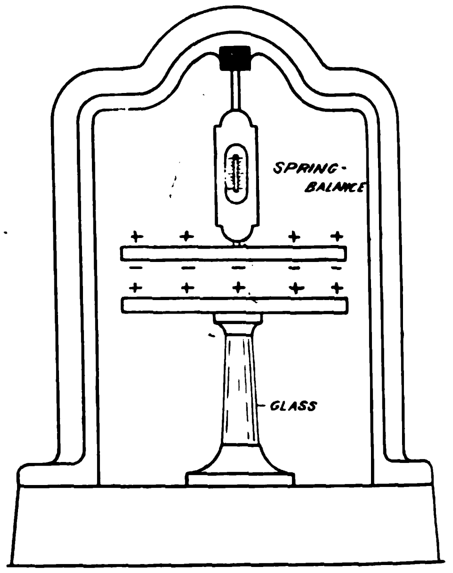


Induction Between a Pith Ball and Glass Rod.

Continuing the argument relating to the pith ball it is now easy to see why it was attracted by the charged rod. It simply obeyed the law "that unlike charges attract each other," and for this reason if the rod was positively charged it attracted the negative electricity in the pith ball developed there by induction. Another question which will arise, however, is this: Why does the pith ball move, even though it is attracted, when it also carries a charge which repels? This is because the attracting charge is nearer to the charged rod than the repelling charge and therefore one force is a little greater than the other.

This idea can be best represented by two metal plates, one of which is insulated and rests on an insulated support, while the other is supported by means of a spring balance. Before the lower plate is charged the force indicated on the spring balance will be merely that of the weight of the upper plate.

When the lower plate is charged with positive electricity induction takes place between it and the upper plate. The lower surface of the upper plate develops a charge of negative electricity, while an *equal* quantity of repelled positive electricity accumulates on the upper surface of the upper plate. The scale will indicate a greater force than before and the difference between the apparent weight when affected inductively and the actual weight of the plate is the extent of the attraction. This, of course, represents the difference as well between the attraction of the positive and negative and the repulsion between the positive and positive of the two plates.



Induction between a Charged and Neutral Body and the Measurement of the Attraction.

If different sheets of materials such as glass, hard rubber, paraffin, etc., are interposed between the two plates it will be noted that the balance will change its record in each case.

An Insulator and a Dielectric.—The change in the record of the spring balance would be due to the fact that different insulating materials, such as those enumerated, cause different degrees of induction to occur between the plates. This power of a body to allow induction to occur through it is called its inductive capacity and such bodies are called *dielectrics*. Therefore when the induction is greater the balance records a greater pull, and when it is less the reverse is true. The amount of induction occurring through air is taken as the standard and is called 1. With reference to this the inductive capacity of other bodies is noted.

When a body conducts electricity it is called a conductor and when it does not conduct electricity the name insulator or non-conductor is employed. One of the best conductors is silver and one of the best insulators is dry air. Between these two are a series of substances which include metals, earths, water, etc., which embrace all types of conductivity. For this reason they are grouped in such a

manner that they comprise the following:

Partial conductors such as metals, wood or earth.

Non-conductors, such as metals, glass or porcelain.

When lightning leaps through the air it breaks down the insulating properties of the air because of the tremendous tension existing between two oppositely charged bodies. When the accumulated charges of electricity reach a certain point, the electrical pressure becomes so great that the insulation is rent by what is called a "disruptive discharge."

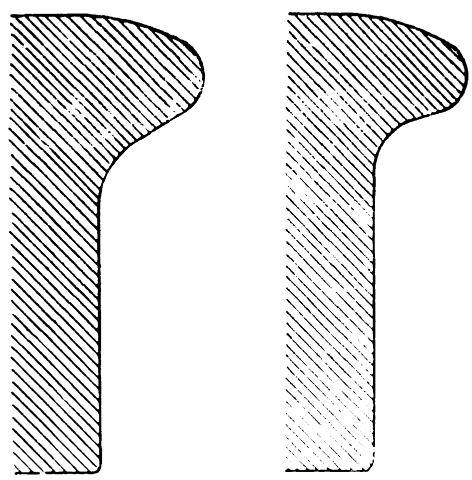
WHEEL MATTERS.*

BY J. MILLAR.

The question of the proper type and maintenance of wheels used under interurban cars which are operated over city streets for any considerable distance, also over more or less special work, has developed into a problem of great importance to the master mechanic.

The ordinary chilled iron wheel with 1 inch flange is ruinous to special work in the city. We formerly used a 500 pound chilled iron wheel with 2½ inch tread and ⅞ inch flange on our Lockport division, and a 450-pound wheel with the same tread and flange on the Niagara Falls division, With both of these wheels we had an unlimited amount of trouble with chipped flanges, having to remove many of them for this reason before they were half worn out, and in several instances, after making but a few trips. As a matter of precaution, I found it necessary to have all wheels carefully examined each trip at both ends of the lines.

We are now using two types of wheels under our interurban cars—steel tired and rolled steel wheels, with 2½ inch tread and ⅞ inch flange. The rolled steel wheels have given very fair results, with the exception of a few which have had to be removed on account of defective plates. As to flange wear, the results with both have been very good. The rolled steel wheels made an average of 35,000 miles before they were taken out to be turned up for the first time, and a few have been turned up the second time with an average of 25,000 miles for the second run. We have only one car equipped with steel tired wheels that has been in service long enough to get any definite data as to wear of flange and tread. These wheels have been in service about 5½ months and have made 34,960 miles. The flange wear is very satisfactory, as can be seen by the following sketches showing section of tread and flange when new and after making the previously mentioned mileage:



You will notice that the flange is lower after having been in service than it was originally, although I use a brake shoe that does not wear on the flange. This I attribute to the special work inside the city limits, the depth of the groove not being enough to maintain a ⅞-inch flange. However, we now have no more broken or chipped flanges, and, as a factor of safety, they are far better than the chilled wheels. The only examination necessary now is for flange wear, which is done in the car stations, whereas, as was previously stated, chilled wheels had to be examined each trip at both ends of the lines.

With both the steel tired and rolled steel wheels, I find that the flanges wear thin on one side of the car, while on the opposite side they are in good condition, necessitating their removal to be turned up sooner than the natural wear would warrant; this I attribute, to a large extent, to the constant running of the car from the same end, which is well known to cause irregular wear.

There are two arguments strongly in favor of the steel tired and rolled steel wheels; first, the factor of safety; second, their freedom from flat spots. During the fourteen months we have had them in use I have not had to remove a single pair on account of being flat.

In summing up steel tired and rolled steel wheels, I will say that the additional safety obtained from their use is of itself enough to warrant their adoption by all roads using high speed interurban cars.

As to "chilled wheels," in following up the evolutions of cast-iron chilled wheels from the time of the old horse car days when with many "a wheel was a wheel," it has been very interesting to note the changes in size, shape and weight, and it has convinced me that the changes have been a betterment to all matters pertaining to rolling stock. We are today using far better wheels than ever before; the mileage derived from cast-iron chilled wheels has, in the past few years, more than doubled itself. This is evident from the fact that the manufacturers have, during the past decade, raised their guaranteed mileage from 20,000 to 40,000 miles, which in itself indicates that progress in wheel manufacture has kept pace with other improvements pertinent to electric railroading.

I have had the mileage taken of 1,458 cast-iron wheels (of the 400-pound type, standard for our city cars) which were removed during the past two years. These wheels made a total of 58,340,478 miles, or an average of 40,014 miles per wheel. Of this number 24 were removed on account of having been broken, 186 for chipped flanges and the balance, 1,248, were worn out.

In regard to flat wheels, if, when first noticed, a good wheel truing shoe is applied, much trouble can be warded off, but if too flat for a wheel truing shoe, grinding down on a grinding machine is the only remedy.

My experience with the grinding of chilled wheels, and after considerable study, prompts me to state that I strongly advocate their being reground, providing the regrinding is done in time, though I am aware that quite a number of heads of mechanical departments are of an adverse opinion. It is impossible for me to give accurate figures here as to the length of time required to grind flat spots out, owing to the variance in the flats themselves; however, on averaging the time, I can safely say that to regrind a pair of wheels on account of "slid flat" with a spot about 1½ inches long, it will take about 30 minutes actual grinding.

In pressing wheels on axles a competent man is an absolute necessity, as the result of carelessness is obvious to all acquainted with the work. He must be accurate in the mating of wheels applied to an axle, and as nearly so as possible, the four wheels in a truck.

The pressure required to press wheels on the axle depends entirely on the quality of metal used in the wheels, also on the axles. The average pressure I use, however, is 30 tons.

In the above I have set forth a few matters which had developed in my experience, and hope that they will provoke comment and discussion which will of themselves be of material benefit to all interested.

*Paper read before the American Railway Mechanical and Electrical Association, held at St. Louis, Mo., October 10-14, 1904.

MODERN HIGH SPEED PRINTING TELEGRAPH SYSTEMS.*

BY J. C. BARCLAY.

(Concluded from page 249.)

The Buckingham system may well be regarded as the most unique and original one in existence, and it will deservedly take high rank among the list of marvelous and useful telegraph inventions of the times. It has been in practical operation over the Western Union lines between New York and Chicago, and New York and Buffalo, for the past six years, and has a maximum working capacity of about 200 messages per hour operated as a duplex. It does not, as will be noticed, utilize the transmitting properties of a wire to the same extent as that theoretically possible with the Rowland multiplex system, but is successfully operative over distances that would not at all be practicable with any synchronous multiplex system as yet invented.

The Buckingham system possesses the disadvantage of requiring a perforated strip for transmitting purposes, but, as in the case of the Rowland, the received record is a direct one instead of having to be translated as in the Murray system. If the perforated tape could be entirely abolished, and a rate of speed obtained by direct manual transmission approximately equal to that obtained in actual practice by automatic working, a grave objection to the Buckingham system would be overcome, and the author is strongly of opinion that such a change is not only desirable, but entirely feasible, and is, in point of fact, well under way.

One other defect of the Buckingham system consists in the fact that the number of characters that can be printed by means of his type-wheel is limited to 32, admitting only of the letters of the alphabet and certain punctuation marks being recorded. To print all of the characters desirable for commercial telegraph purposes would involve some radical changes in the apparatus and greatly increase the already complicated character of the system. By substituting for the present recording arrangement a modified form of electrical typewriter of great sensibility and rapidity in action, a comparatively simple printing mechanism can be devised that will more fully meet the service requirements along the lines indicated, and at the same time increase the legibility and improve the general appearance of the printed message. This is what the author has set out to accomplish, and his experiments so far demonstrate that a speed of at least 100 words per minute can be readily secured thereby. The particular changes necessary to bring this about involve the use of as many small printing magnets as are requisite for the desired number of mechanical operations. As this particular arrangement is the subject of patent proceedings, nothing can be said further than to intimate that the printing magnets are actuated by local currents properly directed through the medium of certain electromagnetic selecting devices, whose particular function is to distribute the different signaling impulses among the various printing and auxiliary magnets in a manner appropriate to the requirements in the case.

In looking over its past history, one cannot but be struck with the fact, and take pardonable pride in the knowledge, that the printing telegraph art constitutes an industry, the origin, growth and development of which may be credited almost exclusively to American inventors, whose persistent efforts in the face of many difficulties and discouragements have at last brought about an extension of its sphere of usefulness into the commercial branch of practical telegraphy. It may be reasonably assumed as a consequence thereof, that the technical and industrial development of this particular art will be much more rapid in the future than it has been in the past; but much remains to be done in the way of simplifying and more nearly perfecting the working apparatus in order to thoroughly complete the task of those early experimenters, who, some 50 years ago, first undertook to solve the problem of devising a practical, useful as well as economical printing telegraph system.

*Paper presented before Section G, Electric Communication, at the International Electrical Congress, held at St. Louis, Mo., September 12-17, 1904.

MAINTENANCE AND INSPECTION OF ELECTRICAL EQUIPMENT.*

BY JOHN LINDALL.

The writer in preparing this paper has been impressed more than ever with the length, breadth and depth of the subject, and its importance as a factor in electric railroading. The difference between success and failure in the "Maintenance and Inspection of Electrical Equipment" very often means dividends or no dividends. Therefore, it behooves the responsible head of this department to give much thought and careful study to this part of the work, ever bearing in mind the old maxim, "A stitch in time, etc.," which is never better applied than in the care of electrical equipment.

Time will not permit me to go into details of inspection and repairs of electrical equipment, even if I were capable of so doing, and it would be presumptious indeed for me to tell the members of this association what is the best practice in this line, as climatic and operating conditions vary to such an extent that what is good practice in New England might be very poor policy in New Orleans or San Francisco. Therefore, I will venture to suggest only a few points which I think may be applicable in general and all important to the successful maintenance of electrical equipment, together with a brief description of methods of inspection and repairs of electrical equipment on the Boston Elevated Railway.

The education of the motorman may not be considered as within the scope of this paper. It is, nevertheless, a fact that the manner in which the car is handled has a very material bearing on the maintenance of electrical equipment, therefore its care should begin at this point. The mechanical department should work hand in hand with the operating department for the proper education and discipline of the motorman, and the running down of ignorant and careless handling of equipment. The advancing of controller too quickly, running on resistance points, unnecessary reversing, failing to cut out defective motor, the substitution of "any old thing" for a fuse, improper closing of switches, running at high speed through water, and running with both power and brakes on, are a few of the things that bring trouble and expense to the electrical equipment. Money expended for the instruction and inspection of motormen is, in the opinion of the writer, well spent.

Defects in the equipment, however slight, should be promptly reported to the proper authority, and in such a manner that they cannot be overlooked. This can best be accomplished by a system of written reports, and instead of the motorman or conductor turning in the car with the verbal report that "This car is on the bum; it was no good when I took it," they should be required to report on a form, provided for that purpose, the nature of the defect, and in case of serious trouble, the location on the line at which it occurred, with a brief statement of the conditions of operations, etc., at that time. This report not only has a morally beneficial effect upon the motorman or the conductor, but when sent to the mechanical department with the defective car, it is of material assistance in locating

*Paper read before the American Railway Mechanical and Electrical Association, held at St. Louis, Mo., October 10-14, 1904.

and determining the cause of the trouble. When evidence of improper handling or carelessness of men is found, the report, with foreman's statement to that effect, should be forwarded to the superintendent, where the question of instruction or discipline is decided.

The proper recording and tabulating of defects is very essential to the successful maintenance of equipment. Simply recording the various failures each day is not sufficient, as the value lies in being able to make quick comparisons, by week, month or year, and to see at a glance whether the various failures are on the increase or decrease, and calling attention to the points which are the most in need of improvement. Also, the history and record of defects of a piece of apparatus should always be at hand and consulted by the man whose judgment determines the course of treatment.

One of the most important factors that we have to deal with in this problem is the education of electrical inspectors and repairmen. The writer is of the opinion that sufficient attention has not been given to obtaining, instructing and retaining in the service competent men, and when we consider that about two-thirds of the cost of maintenance is chargeable to labor account, it certainly seems that too much consideration cannot be given to this point. The development of good men to care for the equipment has not kept pace with the development of the equipment itself, therefore greater inducements should be held out to attract reliable and capable young men to the service. This is not merely a question of wages; congenial surroundings are necessary. I have recently had occasion to visit certain shops and car barns, the equipment of which was comparatively new, yet the conditions were such that no self-respecting man would stop in them. Shops should be properly laid out for the work, kept clean, well lighted, and heated in cold weather. The work necessarily being dirty, lockers for clothing, as well as ample toilet accommodations, should be provided, which would enable the men to leave the shops in a clean and respectable appearance. These are not luxuries but actual necessities, which no well regulated company can afford to be without. They mean a better class of men, better work and more of it. Work should be laid out in such a manner that defective or careless work can be traced back, without any question as to what man is responsible. The men should understand this, also that a record is kept of the cost of work performed by the different men, and that they will be held responsible for results. They should be brought to realize that advancement does not depend merely on length of service, but on their record for obtaining good results at the least cost.

Master mechanics and foremen in figuring to accomplish the greatest amount of work to-day, should also consider the question of making men for the needs of the future, and should make it a point to have men fitted for any vacancy that may occur. They should realize that there is even more credit in turning out good men than there is in turning out good work, and a man who will not impart knowledge to his subordinates, for fear that they will know as much as he himself knows, is not worthy of the position which he holds. Men should be taught why—as well as how—to do work, and to work from cause and effect. They should read the effects to find causes, and not guess at them. A controller which has flashed shows, just as clearly as if photographed, the position of the cylinder at the time of the trouble (if care is taken to note the evidence before it is destroyed) and it is then easy to determine whether it is a case of hot-touch, insulation breakdown or lack of current handling capacity.

The practice of some companies of supplying railroad literature to lobbies, for the use of motormen and conductors, cannot be too highly commended, but I would suggest that if this privilege were extended to inspectors and repair men, it would be appreciated and bring good returns. Of course the periodicals would not be read during working hours, but should be made, to some extent, circulating—one man taking a paper home for a day or two, then pass it along to another man. In this manner an opportunity would be afforded for men to keep posted on the latest improvements and practices, and it would also stimulate an interest in their work.

The inspection of electrical equipment, whether it be on a time basis or mileage plan, should be systematic, and not considered as something to be done when it is convenient and let go undone when it is not. The question of how often to inspect depends entirely upon the equipment and conditions of operation and can best be determined by experiment. It is possible to do too much inspecting, and a great deal of money can be wasted in this manner, but with careful tests to determine how long the different parts of equipment will run successfully without attention, and a system which insures the necessary attention being given at the required time, the chances of failure in service, and cost of inspection, are reduced to a minimum. We must not, however, lose sight of the fact that the primary object of inspection is to prevent failure of equipment in service, and that we should weigh the cost of inspection against the direct loss in revenue, wages of trainmen while handling crippled cars, and loss of patronage due to interrupted service. I might also add the loss caused by the line becoming blockaded during snow storms on account of failures in electrical equipment of cars or plows; and we would not have to go farther back than the last winter to find a number of cases where the line would not have become tied up if that car or plow had not "laid down" at a critical moment, thereby causing a blockade which might have been prevented by proper inspection.

Under the system of inspection on the Boston Elevated Railway surface lines, trolleys, switches, controllers and motors are inspected after three days' service, with the exception of brushes and armature grease cups of some W. P. motors, which are in severe service, and are inspected every day. In general, this inspection is as follows:

Trolleys, to see that pole is straight and securely fastened, that the harp is tight in the pole, that there are at least three days' wear in the wheel, that contact springs, washers, bushings and spindles are not seriously worn and are properly lubricated.

Controllers, to see that they are clean and properly lubricated, that contacts make and break at proper points, that fingers and tips are sufficient for at least three days' wear and that they are not rough and cutting; that cut-out switches work properly, and that wires are firm and show no evidence of heating at terminals.

Main switches, fuse boxes and lightning arresters, to see that contacts are sufficient and in good condition, and that wires are secure in terminals.

Resistance, to see that they are not seriously burned, that they are secure, and connections firm.

Motors, to see that connections and leads are secure and not chafing, also that brushes are not broken and are good for three days' wear, that the brush holder insulation is clean, and sufficient tension in springs, that commutators are clean and smooth, that bearings are properly lubricated, that there is sufficient clearance between armatures and pole pieces, that pinion and gears are tight, that motor gear case and axle collar bolts are tight, and that the casings are not cracked.

The monthly inspection consists of

opening up motors for inspection and cleaning, lubricating and cleaning trolley stands and trolley catchers. Controllers are taken apart yearly, thoroughly cleaned and painted and insulating material shellaced. The wires are also inspected yearly for insulation weakness.

The inspection of the electrical equipment on the elevated trains differs from the surface car inspection but slightly. Contact shoes, switches, controllers and motors are inspected twice a week—no inspection work being done on Sunday. The inspection of controllers with the multiple unit system includes the inspection of master controllers, pilot motors and relays, and testing them. The motor compressor is inspected weekly.

I have already suggested that the best system of inspection is one that is frequent enough to properly take care of the equipment with the least inconvenience to the service. This requires that when a train is due for inspection it should be complete and all parts requiring inspection should be attended to promptly, so that the train may be returned to service and other trains due for inspection taken off without interference with train schedule. It frequently occurs that an inspector finds a part of the equipment which would require considerable time to repair properly, and in order to avoid the necessity of hurried or makeshift repairs or inspection, the system in vogue on the Boston Elevated does not require the inspector to do anything but inspect and make very light repairs. Equipment requiring extra attention is reported to the foreman, who details repair men to that work, therefore no excuse is accepted from inspectors for allowing equipment to go by which is in need of attention. They are held strictly responsible, and are required to report over their signatures the numbers of the cars inspected each day—which practically amounts to a written guarantee of their work. The inspection is made by two crews, each crew being responsible for an equal number of cars; in this manner accurate comparisons can be made and quite a healthy competition aroused, each man trying to make his record just as good or a little better than the other fellow's.

The manufacturing companies have evidently given the question of inspection considerable thought, particularly in their latest types of multiple unit control, where necessary inspection has been reduced very materially.

No repairs are made to electrical equipment at the car houses of the Boston Elevated, except the changing of defective parts. Switches, rheostats, control cylinders, armatures and fields are sent to the Albany Street Shops for repairs; where also are manufactured for the company's use field and armature coils, commutators, motor bearings, brush-holders, trolley wheels, contact fingers, plates, bases, etc.

It may not be out of place to mention at this time a change which we have made in the usual type of contact fingers and cylinder plates. It is not necessary for me to call your attention to the very small percentage of copper which is actually consumed from plates and fingers of the cylinder type of controllers, as compared with the amount which is scrapped, on account of the necessity of maintaining the points of contact at their proper degree for the successful operation of the controller, or to the serious proportion in which this expense grows with the increase of current to be handled. I will, however, ask you to consider this in connection with a very simple but effective means of reducing this cost, which has been found in the adoption of tips for both contact plates and fingers, making it necessary to renew only that part which is consumed or damaged by the arc in breaking current. The fingers are made of cast bronze of about the usual shape and are pressed on the inside, at the end, to receive the copper tip which is secured by two C. S. machine screws. The tip copper is drawn in bars of the required cross section, and the only work necessary is the cutting in proper lengths and drilling and tapping for the two machine screws. The application of the plate tip is still simpler. New plates are not required, as the old plates with the ends worn to the limit are put in a milling machine and the ends cut off and a groove cut for interlocking with the tip, which is drawn of proper shape and cross section, so the only work necessary on it is the cutting off in the required lengths, the same kind of tip being used on all controller plates. This device has been in successful operation for nearly a year, and has been patented.

To the men responsible for the maintenance of motors, there is probably nothing which has given more worry, or been so thoroughly non-responsive to local treatment, as motor flash-overs. In the writer's experience this trouble developed with multipolar motors and the higher speed and voltages, and has been present more or less in all motors of this type under the previously mentioned conditions. Elevated service with multiple unit system and third-rail feeders, etc., is particularly favorable for producing conditions which contribute generously to the combination effecting flash-overs, and it frequently occurs that motors on all the cars in a train flashing at the same time. Engineers are at present giving this matter thorough study. The principal remedy appears to lie in increasing the size of the motor so as to render it less sensitive, and we trust that in the near future motors will be manufactured which will not flash-over. This will surely effect a considerable saving in their maintenance, as burnt brush-holders, springs, armature and field coils, resulting from flash-overs, is not a small item.

THE TELAUTOGRAPH.*

BY JAMES DIXON.

Electrical transmission of handwriting has engaged a certain amount of attention ever since telegraphic transmission of printed characters were successfully carried out.

As early as 1886 Cowper and Robertson brought the writing telegraph into a fairly operative form. This instrument was adapted to operate several receivers in series in "reporting" service, where the regular news ticker service was unobtainable or too expensive. The system was put to some use, chiefly in Pittsburg and vicinity.

The writing was received on a paper tape, advanced at constant speed by clockwork. No pen-lifting device was provided and the words were connected together by a mark of the pen, making figure work poor. As the characters were formed by the combination of the pen motion and the tape motion, a certain amount of practice and skill was required to produce a legible message.

The electrical features were as follows: Two independent variable currents were obtained from the transmitter; these passed over lines to the receiver where they traversed two electromagnets set at right angles to each other, and so influenced their effect upon a common armature as to cause the receiver-pen rod to reproduce the motion of the transmitter pencil.

It will be noted that this principle is nearly identical with that of Gruhn's Telechirograph, recently described in the technical press, the main differences being that the telechirograph writes upon a larger field and uses a beam of light, and photographic record instead of a pen with ink record.

Following the writing telegraph, Prof. Elisha Gray constructed, at his Chicago

*Abstract of paper presented at the 190th meeting of the American Institute of Electrical Engineers, New York, Oct 28, 1904.

laboratory, an instrument which wrote upon stationary paper, and which he called a telautograph. It required four line wires and operated as follows: By means of cords and drums the motions of the transmitting stylus were resolved into two component rotary motions which were used to operate two mechanical interrupters in the primary circuits of two induction coils. The relations of the parts were such that a motion of the transmitting stylus amounting to one-fortieth of an inch caused a complete make-and-break at one or both of the interrupters.

The line currents were the impulses produced in the secondary circuits of the induction coils. These impulses passed over lines to two electromechanical escapements in the receiver. By means of cords and drums their motions were combined and caused to act upon the receiver pen. By the use of relays and condensers and a local battery at each receiver, the paper was advanced when necessary and the pen lifted from and lowered to the paper. The mechanical difficulties met with in perfecting this instrument were very great, and in the apparatus exhibited at the World's Fair in Chicago in 1893 the escapement mechanism was brought to a perfection thought impossible of attainment only a short time before. The writing showed a saw-tooth or step-by-step character due to the action of the escapements. The instrument was abandoned on account of the number of line wires required, limited speed, numerous fine adjustments, and cost and difficulty of manufacture.

In 1893, while still working at the escapement device, Prof. Gray patented a variable-current instrument, using two line wires which worked, in a general way, like the present telautograph. The motions of the transmitter pencil were resolved into two components which were used to vary two line currents, the variable resistances being carbon rods dipping into tubes of mercury. The receiver contained two d'Arsonval movements, to the moving elements of which the pen-arms were attached. Prof. Gray never developed this instrument much beyond the laboratory stage, probably on account of his firm belief in the escapement type.

Foster Ritchie, at that time an assistant to Prof. Gray, gave considerable attention to this patent, and perfected an instrument based on it. He obtained a patent for improvements and has produced an instrument that operates in a fairly satisfactory manner under certain favorable conditions.

The telautograph has been brought to its present state chiefly through experimental work done by, or under the personal direction of Mr. George S. Tiffany, to whom several patents for improvements have been granted. Mr, Tiffany's instrument operates upon the variable-current principle and includes a number of interesting features, among them what may be called a straight-line d'Arsonval movement, which is used to operate the receiver.

The operation may be briefly described thus: At the transmitter a pencil is attached by rods to two lever-arms which carry contact-rollers at their ends. These rollers bear against the surfaces of two current-carrying rheostats, connected to a constant-pressure source of direct current. The writing currents pass from the rheostats to the rollers and from them to the line wires. When the pencil is moved, as in writing, the positions of the rollers upon the rheostats are changed and currents of varying strength go out upon the line wires. At the receiver these currents pass through two vertically movable coils, suspended by springs in magnetic fields, and the coils move up or down according to the strengths of the line currents. The motions of the coils are communicated to levers similar to those at the transmitter, and on these levers is mounted the receiver pen, which, by the motions of the coils, is caused to duplicate the motions of the sending pencil.

Many of the principles and devices in the instruments are of considerable interest. The method by which the variable currents are obtained is the laboratory arrangement for securing a variable pressure from a direct-current, constant pressure circuit; that is, the line circuit (of constant resistance) is connected as a shunt around that part of the rheostat between the moving roller and the ground or return. Motion of the roller varies the amount of resistance in series with the line, and also the amount in parallel with it and fine gradations are easily obtained, giving smooth motion of the receiver pen. In this way a variable pressure is impressed on the line circuit, giving a variable current. In all the other variable-current instruments a constant pressure was impressed on line and a resistance in series with the line varied to give the desired variations in current. One result of the shunting method is a better form of rheostat, more easy of construction and handling, in which, also, the heating is better distributed.

The rheostats are wound upon castings of I cross-section, with the turns of wire lying close together on the inner or contact-face. After winding, the insulation on this face is saturated with glue, which is allowed to harden and is then scraped off, taking the insulation with it, and giving a surface where contact is possible on every turn of the wire. This gives a rheostat of a large number of small steps, of good mechanical construction, and of low cost.

The receiver operates with what may be called a straight-line d'Arsonval movement. The moving element or coil is wound upon a copper shell for damping effect. The magnetic circuit is so arranged that one pole surrounds the other, forming an annular air-gap of short length and large cross-section in which the direction of the flux is radial. The field is electro-magnetic and is highly excited, to secure uniformity. The coil, suspended in the annular space, moves up or down with little friction, as it touches the sides of the space of the core very lightly if at all. The principle is the well-known one that a current-carrying coil, in a magnetic field, tends to place itself with respect to the field so that the flux inclosed by the coil shall be a maximum.

The current for operating is taken from the ordinary lighting mains, preferably at about 115 volts. Satisfactory operation has resulted with pressures from 80 up to 250. At 115 volts, receiver and transmitter each require about one ampere while in operation. Fairly steady pressure is necessary, as the receiver, being in effect a voltmeter, is rather sensitive to sudden changes, the effect being slight distortion of the message.

A master-switch at the transmitter is provided to do all necessary switching of line and power circuits, to make needed changes in connections and to cut off current when not writing. A relay in one of the lines closes the power circuit of the receiver whenever the transmitter at the distant station is switched on, and serves to prevent waste of current when not in operation.

Attached to the master-switch is a mechanical device which shifts the transmitter paper the space of one line of ordinary writing for each stroke of the switch. The relay mentioned controls the electrical receiver paper shifter and, as each stroke of the switch causes a stroke of the relay, the receiver paper is shifted an amount equal to that at the transmitter. The writing space is about 2 inches long and 5 inches wide, allowing for three or four lines of writing. When filled by messages a few strokes of the switch serve to bring fresh paper into position at both receiver and transmitter.

To prevent switching on of the transmitter while its home receiver is receiving a message from the distant station, an electromagnetic lock is connected in the receiver power circuit, controlled by the relay, and locks the home transmitter in the "off" position until the distant transmitter is switched off. If both transmitters were switched on at once neither station would receive any message; the lock is provided to render this condition impossible.

The ink supply is most important and is arranged for as follows: At the left of the receiver platen is a bottle with a hole in the front near the bottom. When filled with ink and tightly corked the ink does not run out of this hole because of the pressure of the atmosphere. The ink is accessible for the pen at the hole and the surface of ink exposed to evaporation is small.

The pen is made of a piece of german silver bent double, after the manner of a ruling pen, and makes a uniform line in any direction over the paper. It takes up its supply by capillary attraction from the hole in front of the bottle. When the receiver is switched off retractile springs draw the pen-arms to stops so arranged as to bring the pen exactly in front of the hole in the bottle, and when the pen-lifter armature is released the pen is caused to insert its tip in the opening. Thus a fresh filling of ink is obtained each time the paper is shifted. When not in use the pen rests in the ink, always ready to write.

For the prevention of mechanical shocks to the necessarily light moving system of the receiver, it has been necessary to supply means to prevent the switching on or off of the transmitter, and by that action of the receiver, when the transmitter pencil is "out of the field," that is, at a position other than that corresponding to the opening in the receiver ink-bottle; as in that case the receiver pen would instantly jump to a similar position. This position is called the "unison point," a term having its origin in the days of the "self-propeller" escapement telautograph. By placing a catch, released only by pressure of the pencil point upon it, at the transmitter unison point the desired result is accomplished and the transmitter master-switch can not be switched either "off" or "on" unless the pencil be placed at the unison point and held there until the stroke of the switch is completed. In this case, as everywhere, the apparatus is made strong enough to stand any possible shocks, and then every precaution is taken to prevent their occurrence. Aside from shock to the moving system these jumps might shake the ink supply out of the pen and prevent the recording of the message.

The pen-lifter is a magnet placed back of the receiver writing platen, and carrying upon its armature a rod adapted to engage with the pen-arm rods and raise the pen clear of the paper when the magnet is energized. This magnet is controlled from the transmitter as follows: Beneath the transmitter platen is a spring contact, opened by pressure of the pencil upon the paper, and closed by a spring when the pencil is raised. An induction coil having an interrupter in its primary circuit is so connected to this spring-contact that when the pencil is raised the primary winding is short-circuited. The induction coil has two independent secondary windings through which the two variable line currents pass before leaving the transmitter. The effect of the induction coil and its interrupted primary current is to induce in the two line currents superimposed vibrations or "ripples" when the pencil is pressed down on the paper and the spring-contact is open When the contact is closed by its spring, and the primary winding is cut out, no vibrations are produced in the line currents. In one of the line wires, at the receiver, is placed a relay upon whose sheet-iron diaphragm is mounted a loose contact, consisting of two platinum-silver contacts in series, sealed in a glass tube, to prevent oxidation. A local circuit contains the winding of the pen-lifter magnet and this loose contact.

When the vibrations are present in the line current, due to the pressure of the pencil upon the paper and consequent opening of short circuit of the primary of the induction coil, the diaphragm of the relay is shaken, the loose contact opened, and the pen-lifter de-energized, its armature is drawn back by a spring and the pen is allowed to rest against the paper. When there are no vibrations in line current due to the raising of the pencil from the paper, the relay diaphragm is at rest and the pen-lifter is energized and the pen is lifted clear of the paper.

The superimposed vibrations used for operating the pen-lifter have another minor effect. The suspended coils, and through them the entire moving system of the receiver, are kept in a state of very slight mechanical vibration while the pen is on the paper. This aids the flow of ink from the pen-point, assists the pen in passing over any roughness or irregularity in the surface of the paper, and materially reduces friction in the joints and pivots of the moving system, and results in better writing. In some of the later instruments the two relays, that for pen-lifting and that for paper-shifting and power switching, are combined in a single piece of apparatus.

For signaling, a push-button is placed upon the transmitter and a call-bell or buzzer is mounted on the receiver. This circuit is disconnected by the master-switch while a message is being written. Spring reels are attached when needed to roll up the received messages for preservation and future reference.

The ordinary arrangements for operation are as follows: the instruments may be operated singly; upon a private line having an instrument at each end, or on an exchange system where a switchboard provides for connection. Working in this way, satisfactory writing has been obtained with a resistance in each line wire of 1,600 ohms and an operating pressure of 110. Multiple operation can be carried out to a limited extent, three receivers being at present the maximum number that can be operated at once, in multiple, using 110 volts. This allows of placing a supervisory machine upon a line.

When no response to messages beyond a bell signal, is required, and the same message is to be sent to a number of stations, a series arrangement of receivers is used. With a transmitting pressure of 110 volts a maximum of seven receivers can be operated from a single pair of transmitting rheostats and rollers. This number may be increased by increasing the pressure or by adding additional rheostats and rollers, operated by the same pencil. Using both these methods a maximum of 50 or more receivers can be operated at once.

Instances in actual commercial use of the arrangements of instruments mentioned are: private lines; the transmission of mail and other orders from office to factory or yards; investigation of checks over lines between paying tellers and bookkeepers in banking concerns, and transmission of messages, usually in cipher, between brokerage firms and cable or telegraph offices. A few moments' thought will bring to mind many places where a telautograph private line could be used to save time and trouble, especially where accurate transmission of figures is essential.

Multiple operation may be resorted to when a third station upon a line desires a record accessible at any time, of what is being sent, as, for instance, when one of the officers of a bank desires to know what passes between his bookkeepers and

paying tellers. On such a line the third station receives all messages and can write to either or both of the other stations should the necessity arise.

Series operation may be used when several stations are to receive the same message and no response except a bell signal is required, as in sending orders in a hotel or club from dining room to kitchen, pantry and wine room, in "reporting or news service, or for bulletin work, such as the announcement of arrival and departure of trains to a number of stations in a large railway station or freight depot.

One of the most important uses for series systems has been found in the U. S. Coast Defense Service, in sending ballistic data, such as range and azimuth of target, or character of projectile, from position-finding stations to the gunners. This is called "fire-control communication" and is installed in the forts by the U. S. Signal Corps. In a paper presented by Col. Samuel Reber on "Electricity in the Signal Corps," will be found a description of the position-finding systems and the desired characteristics of a system of communication for sending this data to the guns are stated as follows: "The system that will successfully solve this problem must be simple in construction, mechanically strong so as not to be affected by the blast, as the receivers are placed close to the guns, rapid in operation and give a character of record that can be read without liability of error." Since that paper was prepared it has been decided that the receivers must be mounted directly on the gun-carriage and can have no shelter other than that afforded by their own cases. Add to these requirements the facts that the instruments must be cared for by post electricians, and operated by enlisted artillerymen, messages must be visible at night; and the operation must be independent of rain, salt mists, cold, heat or tropical insects, and it is apparent that no easy problem is presented.

A special type of telautograph has been designed for this service and has been adopted by the U. S. Signal Corps for fire-control communication.

In this "service telautograph" the pen-lifter controlling relay is eliminated and the receiver pen-lifters are operated over a third line wire by the transmitter platen switch directly.

Each gun receiver is inclosed in a water-tight brass case, suspended by springs from the gun carriage directly in front of the gunner. These parts are, as far as possible, made "brutally strong," and the construction is simple as possible.

The desired rapidity of operation is inherent to the telautograph, and accuracy of record is insured by careful writing and by the use of a "home" receiver, mounted at the transmitter, where the operator can see it plainly, which is connected in series with the gun receivers and records the messages as actually sent over the line.

Freezing of ink is prevented by the addition of alcohol; and rain, mists and insects, as well as the effects of the blast, are shut out by the metal case. A heavy glass window is placed in the case so that messages can be read without opening the case.

A small incandescent lamp inside the case lights automatically when the receiver is writing and may be lighted by pressing a button at other times, thus providing for visibility at night.

On warships there is a somewhat similar service to be rendered and the performance of this should fall to the army type of telautograph.

Commercial service has given opportunity for the installation of a considerable number of private line telautographs in actual use, and at least three of each of the other typical installations are in operation at the present time.

Much of the improvement in details of construction and reliability in operation has resulted from experience gained in efforts to perfect the service of these commercial plants. The experience leading up to the special army type of telautograph has extended over a period of about five years and in the present instrument all the requirements, unusually severe as they are, have been successfully fulfilled.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOV. 1, 1904.

Electric Railways and Appliances.

773,619. Car-Fender. Hugh M. Adams, Washington, D. C. Filed May 14, 1904.

773,621. Combined Trolley-Wire Splice and Support. Alonzo B. Allison, Canton, O. Filed Feb. 15, 1904.

773,694. Traction Means for Street-Railways. Clark L. Varner, Santa Paula, Cal., assignor of one-half to Walter W. Varner, same place. Filed April 28, 1904.

773,893. Trolley-Harp Alson C. Ralph, Somerville, Mass. Filed March 11, 1904.

773,932. Street-Car Fender. Frank J. Fairchild, Toledo, O., assignor of one-half to Frank Powell, same place. Filed Feb. 1, 1904.

774,029. Generating and Distributing Electricity on Railway or Other Vehicles. Frederick J. Beaumont, Stroud Green, Eng. Filed Sept. 30, 1901.

774,043. Trolley. William R. Cooper, East St. Louis, Ill. Filed May 21, 1904.

774,058. Monorail Traction. Charles E. Faroux, Levallois-Perret, France. Filed April 2, 1904.

774,085. Trolley-Pole Contact. John J. Lacknor and Andrew J. Curtis, East Williamson, N. Y. Filed May 5, 1904.

Electric Lights and Appliances.

773,774. Electric-Arc Lamp. Lorens S. Andersson, Stockholm, Sweden. Filed April 15, 1902.

774,805. Incandescent Electric Lamp. Albert W. W. Miller, South Orange, N. J. Filed Sept. 29, 1902.

Electrical Machinery and Apparatus.

773,550. Frame for Electric Machines. Carl Dihlmann, Berlin, Germany. Filed Nov. 23, 1901.

773,615. Frictional Gearing for Motors. Edward W. Wickey, East Chicago, Ind. Filed Jan. 24, 1903.

773,777. Rheostat. William Baxter, Jr., Jersey City, N. J. Filed March 5, 1903.

773,832-833. Controlling System for Electric Motors. George Westinghouse, Pittsburg, Pa., and Louis M. Aspinwall, Wilkinsburg, Pa.; said Aspinwall assignor to said Westinghouse. Filed March 18 and May 1, 1903.

773,836. Controlling-Switch. Harold E. White, Schenectady, N.Y., assignor to the General Electric Company. Filed April 23, 1904.

773,837. Electric Meter. Eddy R. Whitney, Lynn, Mass., assignor to the General Electric Company. Filed Feb. 29, 1904.

773,838-839. Thermo-Electric Generator. Merle J. Wightman, New York City, assignor to the Pyro Electric Company, same place. Filed July 13, 1900, and April 8, 1901. Renewed April 7, 1904.

773,867. Portable Electric Winch. James Heywood, Philadelphia, Pa. Filed March 14, 1904.

773,880. Synchronizing Device for Dynamo-Electric Machines. Louis C. Marburg, Schenectady, N. Y., assignor to the General Electric Company. Filed March 7, 1904.

773,881. Commutator. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed March 19, 1904.

773,918. Means for Exciting Dynamo-Electric Generators. William L. Bliss, Brooklyn, N. Y., assignor to the Bliss Electric Car Lighting Company, New York City. Filed Feb. 26, 1902.

773,930. Electric Motor. Frederick B. Duncan, Madison, Wis., assignor to the Northern Electrical Manufacturing Company, same place. Filed May 10, 1901.

773,950. Electric Turret-Operating Mechanism. Osborn P. Loomis, Newport News, Va. Filed Dec. 16, 1903.

773,977. Device for Transmitting Power. Carl F. Pearson, Chicago, Ill. Filed Jan. 29, 1904.

774,012. Electrical Stop-Motion Mechanism for Textile Machinery. Joseph B. Whitney, New York City. Filed Oct. 21, 1903.

774,018. Alternating-Current Motor. Caspar Wust-Kunz, Seebach, Switzerland. Filed July 29, 1901.

774,019. Electric Time-Switch. James E. Yates, Schenectady, N. Y. Filed Aug. 12, 1903.

774,099. Alternating-Current Selector. Hermann Lemp, Lynn, Mass., assignor to the General Electric Company. Filed Dec. 1, 1897.

Telephones and Telephone Apparatus.

774,059. Electrical Alarm for Telephone Call-Bells. John W. Fouche, Ryan, Va., assignor of two-thirds to Hugh B. Hutchison and Clarence A. Hutchison, Herndon, Va. Filed May 2, 1904.

774,082. Time Metering Charge for Telephone Services. Isidor Kitsee, Philadelphia, Pa. Filed May 17, 1904.

774,139. Telephone-Directory. Nathan B. Porter, New York City, assignor, by mesne assignments, to the Telephone Appliance Company, Ossining, N. Y. Filed Oct. 22, 1893.

Miscellaneous.

773,685-686. Storage-Battery Electrode and Process of Making Same, and Storage Battery. Elmer A. Sperry, Cleveland, O. Filed Jan. 28, 1904; Feb. 11, 1904.

773,821. Electric Furnace. Charles P. Steinmetz, Schenectady, N.Y., assignor to the General Electric Company. Filed May 24, 1900.

773,827-774,118. Roentgen-Ray Tube. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Original application filed Feb. 14, 1898. Divided and this application filed April 26, 1902.

773,853. Electric Kiln. Frederick E. Dickinson, Kendallville, Ind. Filed Jan. 12, 1903.

773,868-869-870. Automatic Electrical Signaling System. Franklin S. Holmes, New York City. Filed April 16, 1903; March 19, 1904 and March 25, 1904.

773,917. System of Electrical Distribution. William L. Bliss, Brooklyn, N. Y., assignor to the Bliss Electric Car Lighting Company, New York City. Filed Feb. 3, 1902.

773,931. Electrically-Controlled Monogram Sign. Mortimer Du Perow, Washington, D. C. Filed May 9, 1904.

773,961. Storage Battery. Charles L. Morgan, Cleveland, O. Filed April 18, 1904.

774,041. Metallic Vessel. Charles L. Coffin, Detroit, Mich., assignor to the Electric Metal Working Company, same place. Filed May 4, 1903.

THE TELEPHONE WORLD.

Independent Telephone Securities Company's Organization.

Sholes, Ferris & Foley, of Utica, N. Y., are engaged in drawing up articles for the incorporation of the Independent Telephone Securities Company, which is about to be organized. and which will have its headquarters in Utica. The object of the proposed corporation is to purchase the stock and bonds of the Independent telephone companies, and of holding the controlling interest in those companies for the primary purpose of improving the service and strengthening the different local plants. The company will have a capital stock of $800,000, and an authorized bond issue of $15,000,000. The directors will be Thomas W. Finacune, of Rochester: Frederick W. Zoller, secretary of the Union Trust Company of Rochester; George R. Fuller, manager of the Rochester Telephone Company; Charles H. Poole and T. Harvey Ferris, of Utica. The company will have in its treasury securities amounting to $428,000, representing the control of the Utica Home Telephone Company, the County Telephone Company of Herkimer, and the Otsego Home Telephone Company. The Rome Home Telephone Company and the Little Falls Telephone Company are also represented as being about to come in

A movement is on foot to put in a new telephone system at West Palm Beach, Fla., with a probability of making it a long-distance system. For several years the East Coast Telephone Company has had a franchise, but for some reason the system has not been well patronized, and it is now claimed by many that they need 'phones, but find the present system does not meet the demands of the city.

In about a month's time the telephone system of the city of Macon, Ga., will be in the new building now nearing completion on the corner of Poplar and Second streets. The apparatus for a largely increased business has been placed in the new building and a number of telephone experts have been on duty placing this apparatus for several weeks.

The Maysville, Ky., Telephone Company recently purchased the telephone franchise in Mason County for $100. The sale was made by the Mason Fiscal Court, and was for a period of 20 years, to construct, maintain and operate telephone lines on and across and along all public roads and turnpikes and across and under any navigable waters in Mason County.

The Pacific States Telephone & Telegraph Company is putting all its wires in the business portion of Oakland, Cal., underground as rapidly as possible. Permits were granted by the board of public works to the company to construct three conduits in the heart of the business district to carry these wires.

A telephone company in Waldon, Minn., has been organized and will build a line to Starbuck.

The Rural Telephone Company of Mullica Hill, N. J., opened its line for business last week.

A new telephone exchange has been placed in Lorena, Tex.

Will Extend 'Phone Lines.

Ole Jenson, of Cadott, was in Chippewa Wis., lately on business connected with the Cadott Telephone Company, of which he is sole owner and manager. This line is more familiarly known as the Jenson Telephone Company to the people of Chippewa. The company is growing at a rapid rate, now having over 100 miles of lines of its own, while there are connections with over 400 miles of line.

Mr. Jenson says that he now has connection with Chippewa Falls, Bloomer, Eagle Point, Augusta, Fall Creek, Boyd, Stanley, Bruno Falls, Edson, Colburn, Holcombe, Eau Claire and a number of other places of less importance. Mr. Jenson stated that a new line will be erected this fall between Stanley and Thorp, a distance of eight miles, and that work upon the same would be commenced at a very early date, in fact, just as soon as telephone poles could be secured to start the construction

The extension from Stanley to Thorp will give connection with 58 subscribers at Thorp. The rapid extension of the 'phone system is evidence of a thriving and growing business.

The poles along the United Telephone Company's line between Martinsburg and Roaring Spring, Pa.—recently acquired by the Morrison's Cove Telephone Company—have been reset and equipped with cross arms to carry three lines of wire. As soon as the work on the line to Roaring Spring is completed another circuit of wires will be strung from Martinsburg to Williamsburg. The temporary connection between Martinsburg. Roaring Spring and Altoona has been made.

The Central Union Telephone Company and the Postal Dispatch have joined issues and instead of two lines through Averyville and Prospect Heights at Peoria, Ill., there will be one. Either company has many wires and in order that they string together, poles of great size and strength are required.

The local telephone company at Humboldt, Neb., has completed the work of putting in a large cable to assist in caring for the greatly increased business during the last few months. The bringing to the city of the rural exchanges adds much to the work of the local central and the managers are having a hard time to keep up with the demand for increased service.

The Bruceton & Fairchance Telephone Company has been incorporated in West Virginia with a capital stock of $100,000, and purposes to build a line from Bruceton, W. Va., to connect with the lines of the Tri-State Company at Fairchance, Pa. The officers are: J. H. Walls, Brockville, W. Va., president; George B. Irwin, Fairchance, vice-president.

The Norwood, O., council has ordered the application of the Queen City Telephone Company to be filed, as a result of the recent reversal of the decision of the Probate Court, giving the corporation certain rights in Cincinnati.

The new telephone system which is being installed in Augusta, Me., by the Northeastern Telephone Company of Portland, is nearing completion.

The National Telephone & Telegraph Company of West Virginia has been admitted to Indiana, and the company has filed a certificate of incorporation and a declaration to invest $175,000 in the building, equipping and operating telephone exchanges, toll lines, etc. The company also proposes to lease or connect with other telephone plants owned or operated by other individuals or corporations. The company's principal office will be in Fort Wayne. and in charge of William L. Moellering, who has been selected as State agent. The Indiana stockholders are Frank H. Cutshall, William Paul, and George T. Cox, of Fort Wayne.

A report from Mexico is to the effect that a second extensive telephone system will be installed in the Federal capital. It is said that the firm of L. M. Ericsson, of Stockholm, Sweden, has secured the entire contract for the new installation. The Ericsson Telephone Company is also understood to be making arrangements to install other telphone systems on this side of the Atlantic.

The Home Telephone Company of Los Angeles, Cal. (an Independent concern), reports the installation of 20,000 telephones. There are nearly 200 private branch exchanges, some having 300 telephones. At the present time long distance lines are being projected which will eventually cover the whole of that State, with a network of lines that will tap every village.

The new telephone system, which is being installed at Togus, Me., by the Northeastern Telephone Company, is nearing completion.

Work has begun on the new telephone line from Chamblee to Dunwoody, Ga. Citizens will soon be talking to Atlanta by way of Chamblee, as well as by the Roswell exchange,

The New England Telephone Company will soon connect up with the line at Island Falls, Me., which will make over 100 'phones in the Island Falls central.

President G. A. Starrett, of the Commercial Club of Sheldon, Ia., is to ask the city council for a franchise for the construction of an Independent telephone system.

The Oswego, N, Y., Telephone Company has elected the following officers- Dr. W. A. Moulton , president; Thomas Dean, vice-president; B. R. Whitcomb, secretary; W. H. Clark, treasurer; B. H. Sutfin and G. H. Horton, trustees.

Representatives of the telephone exchanges in Southern Wisconsin and Northern Illinois recently met in Janesville and organized an association.

With a capitalization of $4,000 the Maplesville & Selma Telephone Company has been organized at Selma, Ala.

The Barnum, Ia., Telephone Company will install a local exchange. It has a capital stock of $10,000.

Ellsworth, Kan., is the home of a new concern known as the Lyons Telephone Company. with a capital of $12,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Argenta, Ark.—Municipal ownership of the electric light plant is being considered.

Beaver Springs, Pa.—The Beaver Springs Electric Light Company has lately been incorporated with a capital of $6,000.

Central City, Ia.—The citizens will vote on an electric light plant.

Charles City, Ia.—A. L. Dodd and others seek a franchise for an electric light plant. Contracts will be let in the early spring.

Crab Orchard, Neb.—This city is considering the project of installing an electric light plant.

Danville, Pa.—This borough is issuing $30,000 worth of bonds for an electric light plant.

Elk Mound, Wis.—An electric light plant is being talked of here.

Georgetown, Ill.—This place may soon have an electric light service. A. M. Searles, of Chicago, has made the town board a proposition in regard to installing a system, which will furnish both arc lights for municipal use and incandescents for private use. This proposition is being considered by the council and may be adopted.

Greer Depot, S. C.—The town council has been discussing the advisability of putting in electric lights.

Guthrie, Okla.—The city council has been asked to grant a franchise for 30 years to the Guthrie Electric Light & Power Company, which was incorporated with a capital of $150,000. The company will rebuild the old electric light and gas plant here, and otherwise improve the system.

Hagerstown, Ind.—A movement has been started among local business men to organize a company for the purpose of building an electric light plant. The council will be asked to contract for street lights with the new company, and in case the number of street lights agreed upon are satisfactory to the proposed company the organization will be entered into at once and work commenced at an early date.

Hallock, Minn.—The Hallock Light Company has been incorporated, and will generate gas, steam and electricity for lighting, etc. Edward McVean, Peter H. Konzen and others are interested.

La Grande, Ore.—A company, which has been formed by Walter M. Pierce, T. H. Crawford, Surveyor Berry and others, will soon establish a waterworks plant two miles above Cove. This power will be used for electric lights at Hot Lake, Cove and possibly at this place and other points, as well as for other purposes.

Livingston Manor, N. Y.—This place will shortly be lighted by electricity. A company has been formed for this purpose, capitalized at $32,000, composed of F. M. Woolsey, president; V. A. Finch, vice-president; George S. Woolsey, secretary; W. R. Woolsey, treasurer; Wm. F. Scudder, superintendent; L. E. Woolsey, director.

Los Gatos, Cal.—F. D. Farwell, manager of the Ice & Power Company, states that the company is now preparing to enlarge its facilities for power in this place, by replacing all its generators with larger ones, so as to be able to meet any demand for light and power that may be made upon it.

Lowell, Mass.—The Lowell Electric Light Company has petitioned the board of gas and electric light commissioners to increase its capital stock from $600,000 to $660,000. The proceeds of the new stock will be applied to additions and extensions.

Milford, Utah.—J. W. Clark, of La Porte, Ind., has secured the contract to light this town with electricity.

Minneapolis, Minn.—A new electric plant for power and lighting purposes is to be established by the State board of control at the State University. It is expected that the contract will be awarded soon.

Monroe, Mich.—A resolution has been passed calling a special election for November 14 to submit to the taxpayers a proposition to bond the city for $25,000 to build a municipal electric light plant.

New Orleans, La.—City Electrician Smith has been making some investigation into the electric wiring in the city, and he finds that a good deal of it is of a poor quality, and has plans on foot to improve conditions here in this respect. All wiring that is being done in the city now is rigidly inspected, and if not right, is condemned.

Pittsburg, Pa.—The councils here have been asked to grant a franchise which will permit another company to engage in the electric light business in competition with the Allegheny Electric Light Company.

Richland Center, Wis.—A motion has been approved by the city council ordering two new boilers put into the electric light plant. Reuben Sutton, city clerk.

Sioux City, Ia.—An ordinance granting Edward Tilden and Samuel McRoberts the authority to erect, maintain and operate an electric light plant here was carried.

Stoughton, Wis.—At the special election the citizens, by a large majority, voted in favor of bonding the city in order to build a municipal light plant.

Troy, Mo.—The proposition to bond the city for $10,000 to erect an electric lighting plant was carried at the special election.

Wilton, Me.—The Wilton Electric Light & Power Company, capitalized at $10,000, has the following officers: President, A. V. Adams; treasurer, C. N. Blanchard, both of Wilton.

Youngstown, O.—An electric light plant is to be installed in the penitentiary here.

STREET RAILWAYS.

Bath, N. Y.—The town council is considering the application for a franchise made by Attorney Shutts, of Rochester, representing Richard Barlow's Company, who desires to construct and operate an electric line through this town.

Leslie, Mich.—A franchise has been granted to Wm. A. Boland, of Grass Lake, and W. Wilson to build an electric road through this place.

Logansport, Ind.—The Indianapolis, Logansport & South Bend Traction Company has been organized with a capital stock of $10,000. The directors are N. K Caulfield, G. H. Leslie and others.

Montreal, Can.—An informal proposal has been made by the directors of the Montreal Incline Railway for permission to construct an electric railway from the top of the incline tracks to the cemeteries.

Princeton, Ind.—The Pocket Interurban Railway Company has been organized here for the purpose of building electric suburban lines throughout this part of the State. Jasper D. Davidson is at the head of the movement.

Rochester, N. Y.—The Albion & Rochester Electric Railway Company has applied for a franchise to extend its line.

Saginaw, Mich.—The Detroit, Flint & Saginaw Electric Railway Company will build a new power house at Bridgeport.

St. Paul, Minn.—More miles of railway will be constructed in the Northwest next year than in several years, according to well-informed railroad men. No long lines are likely to be built, and the mileage will be distributed among a host of feeders, 20, 50 or 100 miles long. The feature of the new construction planned for next year is the great number of short electric roads projected in the Pacific Coast States. Not less than a dozen lines are expected to be built in Washington and Idaho. following the irrigated valleys, which yield such heavy and rich traffic. Water power will be used in most instances to generate electricity for the roads which connect with the large systems.

Topeka, Kan.—The Wellington & Cowley County Traction Company has been incorporated with a capital of $500,000. The directors are G. H. Hunter, H. P. Northrup and others. The object of the concern is to build a network of electric railways in Sumner and Cowley Counties, with Wellington as the hub. All of the big towns in those two counties, including Wellington, Winfield and Arkansas City, are to be linked together.

West Chester, Pa.—President O'Connell, of the Oxford, Cochranville and Parkesburg Electric Railway, recently stated that he had about concluded arrangements with the Philadelphia Trust Company to furnish bonds in $300,000, for the building of the line across country that is to connect Parkesburg with Oxford, a distance of 15 miles. The rights of way have been secured.

York, Pa.—The York County Traction Company's engineer corps is at work making a survey for the proposed new trolley lines.

POWER PLANTS.

Omaha, Neb.—It is said by a man closely connected with the Sarpy Mills project of the Omaha, Lincoln & Beatrice trolley line, that it is proposed to develop part of the power from the Pappio River at that place. The management of the road has purchased a large amount of land there through P. E. Iler, of Omaha. The Sarpy Mills project is said to include the erection of a power plant, car houses and other necessary buildings.

Portland, Ore.—Articles have been filed giving to Willard P. Hawley and Joseph M. Healey, of this city, all right, title and interest in and to the North Santian River along three claims above the town of Gates, including the right to divert the waters of the stream by canal, flume or pipe. The claimants, who transferred their interest in the Santian to Hawley and Healey, did so with the expressed understanding that the latter construct a canal, ditch or flume for electric power or other power purposes within three years.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 13¾@14c.; Lake 13¾@14c.; casting, 13½@13¾c.

The Standard Storage Battery Company has been incorporated in New Jersey with $500,000 capital, by Lewis B. Dailey, H. C. Coughlan and B. S. Mantz.

There is little likelihood of any improvement in Massachusetts Electric affairs until winter and it is not expected that the earnings of the system will show any improvement this year over last.

The New York & Queens County Electric Light & Power Company has declared a dividend of 2½ per cent. on the preferred stock for the half year, payable December 1, to holders of record November 15.

A Philadelphia dispatch says the reorganization committee of the Lehigh Valley Traction Company has further extended the time to November 15 as the last day upon which securities may be deposited in assent to the reorganization plan.

A high official of the United Gas Improvement Company of Philadelphia says there is absolutely no truth in the statement that negotiations looking to the acquisition by the United Gas Improvement Company of the American Light & Traction Company have been reopened.

There is a report in circulation that the Morton Trust Company has paid par for control of the Metropolitan Securities of New York and that other large stockholders have been paid $90 per share, ex-commission for their stock. It is stated that a comprehensive combination is under way.

The Pittsburg Reduction Company, manufacturer of aluminum, with works at New Kensington, Pa., and Niagara Falls, N. Y., has just declared a stock dividend of 100 per cent. It has been paying annually dividends of 12 per cent. in cash for some years.

The directors of the Edison Electric Illuminating Company of Boston have voted to issue 10,450 shares of new stock at $200 per share on the basis of one share of new stock for every ten held. A special meeting of stockholders will be held to act on the increase November 18.

It is stated by those in a position to know that the Chicago Union Traction earnings are not sufficient to pay the dividends on West and North Chicago shares after deducting the amounts ordered by the court set aside for depreciation and maintenance, and the interest on borrowed money is paid.

Judge Grosscup has entered an order authorizing the receivers of the Chicago Union Traction Company to replace $400,000 of receivers' certificates that matured August 1, 1904, with new certificates for the same amount, to run until February 1, 1905, with the privilege of extension until August 1, 1905.

B. L. Smith of Chicago is now in New York conferring with J. P. Morgan & Co. regarding the Chicago Traction situation. Mr. Smith holds a large block of Chicago City Railway stock and Morgan & Co. are said to desire him to unite with the Eastern Union Traction interests in the consolidation of the two properties.

Attorney-General Cunneen announces that the argument of the appeal in the New York special franchise cases in the United States Supreme Court will be made on December 19, this date having been agreed upon by all parties interested. Taxes levied under the special franchise tax law are estimated to amount to over $6,100,000.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Nov. 7.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	162
Metropolitan Street Railway	124
Metropolitan Securities	82¾
Ninth Avenue	197
Third Avenue	132
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	68¼
Public Service Corporation (New Jersey)	104
Philadelphia.	
Consolidated Traction of New Jersey	75
Philadelphia Traction	98
Union Traction	56¾
Boston.	
Boston Elevated	154⅛
Massachusetts Electric Companies, com	13¾
do. do. do. pref.	55¾
West End Street, com	91⅛
do. do. do. pref.	111¼
Chicago.	
City Railway	185
North Chicago	71
Union Traction, com	9½
do. do. pref.	39
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	13
do. pref.	60½
Electric Boat, com	40
do. do. pref.	72
Electric Lead Reduction	½
Electric Vehicle, com	15
do. do. pref.	22
Westinghouse, com	169½
do. pref.	190
General Electric	174¼
Boston.	
Edison Electric Illuminating	250
General Electric	174
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	160
National Carbon, com	37
do. do. pref.	110
Philadelphia.	
Electric Company of America	9⅞
Electric Storage Battery, com	74
do. do. do. pref.	74
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	142
Western Telephone Company	19
New England Telephone Company	133¼
New York.	
American Telegraph & Cable Company	92
Commercial Cable Company	210
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	91⅛
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	40
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

How Nature Produces Light.

The imitation of nature by man, for the purpose of developing a new invention, is to-day one of the surest roads to success. Since the days of the Montgolfier brothers, balloons by the thousand have been built. Glaisher rose seven miles above the earth in one, and took records while holding the valve cord in his teeth, so that when he became unconscious and fell to the bottom of the car the balloon would descend.

Renard and Krebs built a dirigible air ship, that is, one that could be steered; and finally Lilienthal in Germany and Langley in America, by trying to imitate the flight of birds, succeeded in building, in one case a man-flying machine and in the other an automatic air-ship, both possessing features which heralded a distinct advance in the art. By these brief illustrations of the work done in this direction, some idea can be gained of the efforts made in an entirely different field—the field of electric lighting. Here, as in the other cases, problems present themselves which call for a solution along those lines laid down by nature and apparent to us in the marvelous cold light given out by various insects and glow worms.

That is the idea at present, to produce cold light. As the saying goes: "It is easier said than done." But the fact of the matter is, that considerable has been done. A review of the situation with regard to lighting in general discloses the fact that progress has not been confined to the application of electricity for lighting, but remarkable advances have been made in the use of oil and gas in connection with rare oxides such as the Welsbach mantle for the purpose of producing a more brilliant and more efficient source of illumination.

So the list goes on increasing from the torch to the candle, from the oil lamp to gas, from the incandescent lamp to the vacuum tube. Here we begin to meet with the possibilities of cold light or heatless light as some would prefer to call it.

All of the means above quoted, although having as their ultimate object the production of light, do not succeed in that respect. They are heat producers and the light is only a secondary effect. Take a few figures and see the result. A gas jet wastes about 99 per cent. of the latent energy of the illuminant in heat; only 1 per cent. reaches the eye. An incandescent lamp wastes 97 per cent. in heat and only 3 per cent. reaches the eye; and, finally, the arc lamp, the most efficient of all known sources of artificial light, dissipates 90 per cent. of the energy of the current in heat and only 10 per cent. appears as light. This means that in electric light plants supplying power to incandescent lamps, for every hundred pounds of coal burnt in the boiler from two to three pounds appears as light. Surely the economy of nature is greater in the light-producing insects who give out enormous quantities of light relatively, without impairing their vitality or activity to any noticeable extent; and the light they produce is the kind sought for so fervently—cold light.

* * *

Determining Electrode-Potentials in Solutions.

In order to determine electrode-potentials in solutions the concentration of which in contact with the electrode should be known as accurately as possible, Dr. Henry J. S. Sand has elaborated a method for the measurement of potentials of electrodes in stationary liquids free from convection

currents, and he gave a description of his apparatus, method and experiments before the London Faraday Society on October 25. The apparatus which he employed was designed so as to allow the electrode to be placed accurately horizontally at the top or at the bottom, according as the electrolyte becomes lighter or heavier during electrolysis. The liquid connection to the normal electrode is tapped off about 3 or 4 mm. in front of the electrode, the resistance between the junction and the electrode being found either by calculation or else directly by means of a Wheatstone bridge arrangement for alternating currents, partly composed of condensers instead of resistances. Dr. Sand checked his method by a series of experiments with a copper-sulphate solution, and it gave satisfactory results for the diffusion coefficient of copper sulphate. The electrode-potential of a silver solution showed irregularities which are being further investigated.

It was found that when two reactions take place, the method might show their successive occurrence by a sharp break in the potential time curve, analogous to Nernst & Glaser's breaks ("knickpunkte") in their potential-current curves; the conditions existing at the electrodes, were, however, more definitely known than in the "knickpunkte" method. An alcoholic solution of cuprous chloride which had become partially oxidized to cupric chloride showed such a break corresponding to the processes; reduction of cupric chloride and deposition of copper. When acid solutions of nitro-benzene were electrolyzed the time-potential curves showed characteristic retrogressions of potential after a definite time, possibly corresponding to charges in the condition of the cathode. From experiments on alkaline solutions of nitro-benzene a lower limit for the diffusion coefficient of nitro-benzine in the solutions experimented upon, was calculated, and it was shown that Haber's results regarding the dependence of electrode-potential or current-density, cannot be explained by concentration changes at the electrode.

There was some discussion following the paper, in which Dr. F. M. Perkin referred to the great practical importance of potential measurements, and Prof. Threlfall said he thought that the method of employing a capillary tube in connection with the cathode for measuring electrode potentials, would yield as accurate results as Dr. Sand had obtained. Dr. Sand, however, disagreed on this point, contending that the capillary tube method was useless in experiments of this character, which were really diffusion experiments, as he was most anxious to avoid convection currents.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The plant of the General Electric Company at East Lyme, Conn., for the manufacture of turbine engines, is approaching completion. It will employ, when in operation, 3,500 men.

Since the opening of the New York subway the average number of passengers carried by the elevated line has been about 1,000,000, and has fallen off only 7½ to 8 per cent. Travel in the subway averages now about 225,000 a day. There is no appreciable falling off in the surface car travel. The increase in the subway business is over one-half, entirely new travel.

It is stated that an attempt made by the Indian Government to establish wireless telegraphic communication in Burmah between Diamond Island and Amherst, a distance of 212 miles, across the Irrawaddy Delta and the Gulf of Martaban, was not altogether successful owing to atmospheric disturbances. We understand, says the "Electrician," London, that the experiments were carried out with the view of establishing communication subsequently with the Andaman Islands.

A foreign paper states that as a competitor of electricity alcohol is now engaging much attention as an illuminating and industrial agent in Brazil. Its employment is much advocated in the interest of the sugar industry of the country, which has fallen into a very precarious condition. An exhibition of apparatus used in the production of alcohol and its application did much to show the public the possibilities of the article, and it is expected that an increased demand for commodities connected with this branch of trade will result.

The necessity of protecting underground electric railways against fire has been engaging the attention of the London County Council. In approving such schemes, says the London "Electrical Engineer," the Board of Trade will include a direction that efficient hydrants, hose and fire-prevention appliances shall be provided; and the Board has suggested to the Council that the chief officer of the latter's fire brigade shall certify as to the sufficiency of the apparatus.

Civil Justice Van Wart, in the second district Municipal Court, of Brooklyn, has handed down a decision that street railway companies, can be forced to give transfers on transfers.

A patent has been issued to a man in Chicago for a method of converting the energy of fuel directly into electrical energy. It consists, according to "Power," first in combining a metal, the oxide of which yields chiefly carbon dioxide in addition to the metal in its reduction by carbon, as the positive plate with an alkali as the electrolyte in a galvanic cell, generating electrical energy by oxidation of the metal, and then reducing that battery product which contains the metal oxidized in the battery reaction to the metal by means of the oxidation energy of fuel, and repeating the oxidation of the metal with generation of electrical energy.

The biggest thing in subways just now —next of course, to Mr. McDonald's—is the Simplon tunnel under the Alps from Brieg to Isella. The tunnel is 12 miles long and costs about as much per mile as New York's. Instead of running under a Tenderloin, it has at one point more than 4,000 feet of solid rock above it. The New York subway, says the "Daily World," was troubled by underground streams of water. The Simplon work was recently almost stopped by hot-water courses in the rock. Whence came they? The mountains above are snowy much of the year and cool always. The crown of the Simplon tunnel is nearly half a mile above the sea.

An English journal states that it is cheaper to produce electricity in large quantities than in small ones; hence up to a certain limit it is preferable to put all the generating machinery under one roof as far as possible. Beyond a certain point, the increase in the size of units and station may become undesirable, and the additional cost of supervision and maintenance may be so great as to warrant building a separate station. Exactly where this limit is depends, in each individual case, on several circumstances—for instance, the distance of transmission, the available sites of the power stations, and local conditions generally.

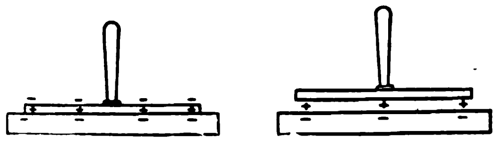
R. H. Derrah, author of "Derrah's Street Railway Guide," has been appointed general passenger agent of the Massachusetts Electric Companies, the first position of its kind ever created by a street railway company.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

STATIC ELECTRICITY.

Electrophorus.—To produce static electricity continuously without having to resort to the rather primitive method of rubbing a rod of glass or hard rubber with a silk or woolen rag, a device is employed which involves the action of the two laws and the principle of electrostatic induction. It is called the electrophorus and consists of a plate of hard rubber or



Electrophorus with Plates in Contact also with Plates Separated and the Free Electricity Removed.

resin on which rests a detachable brass plate with an insulated handle.

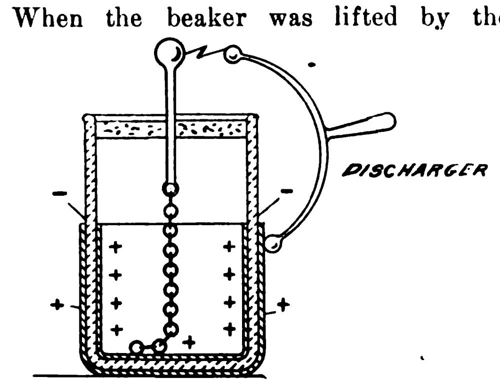
The hard rubber plate is beaten with a piece of cat's fur or a woolen rag and becomes strongly electrified. The brass plate is then rested upon the rubber plate and the finger then placed upon the brass plate for an instant. If the brass plate is lifted up carefully by its handle and the knuckle presented to it a spark will show that quite a discharge has taken place. If the plate is put back, then touched with the finger and removed and discharged and the operation repeated a dozen times, it will become evident that in this device electricity can be obtained continuously without applying friction more than once to the under plate.

In the first place, when friction is applied, negative electricity is developed. This charge acts by induction on the brass plate resting on it and positive and negative appear. The positive is held on the under side of the brass plate by induction and is called a *bound* charge. The negative is repelled to the upper surface of the brass plate and is called a *free* charge. The free charge may be removed by touching the plate with the finger. When the plate is lifted away by its handle, the bound positive becomes free, because it is removed from the inductive influence. It can be discharged by presenting the knuckle and is then ready for a repetition of the process.

The question is asked "Why does induction take place when the brass plate *rests* on the rubber plate?—and the answer is, that a film of dry air acts as insulation between the two plates. The inequalities of surface account for this; otherwise, if the surfaces were absolutely flat and therefore in intimate contact, the negative electricity of the under plate would pass into the upper brass plate and there would be conduction instead of induction.

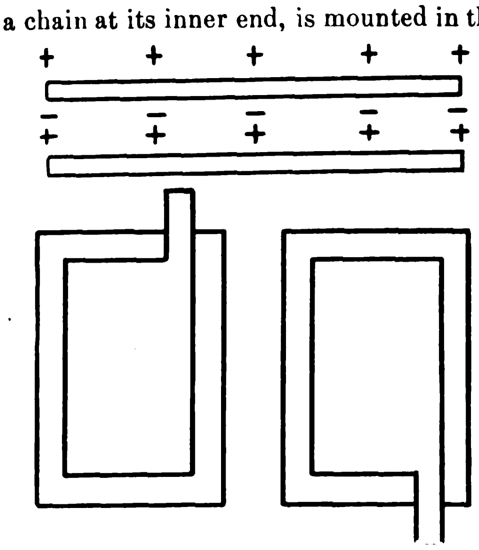
The Leyden Jar and Condenser.—Electricity can be accumulated or condensed so that small quantities regularly supplied to the proper device can be gathered into one large charge. The original name for such an invention was a Leyden jar, but in its more modern form it is called a condenser.

The town of Leyden, Holland, was, according to tradition, the scene of the following incident a few centuries ago: A beaker of water holding a metal stirring rod rested on a stand near an electrical machine. Sparks from the machine entered the rod and charged the water. When the beaker was lifted by the



Leyden Jar with Induction Revealed and the Free Electricity Present.

natural philosopher's assistant with one hand, and the other touched the rod, a terrible shock was experienced by him and the beaker was dashed to the ground. This meant the discovery of a means of condensing a series of small charges, so that when so held they were capable of discharging in one great flash. A Leyden jar consists of an inner and outer coating of tinfoil attached to a glass beaker. A metal rod with a knob at its outer end and a chain at its inner end, is mounted in the



Plates of a Condenser, showing Induction and One Paraffined Sheet with Tinfoil on Each Side.

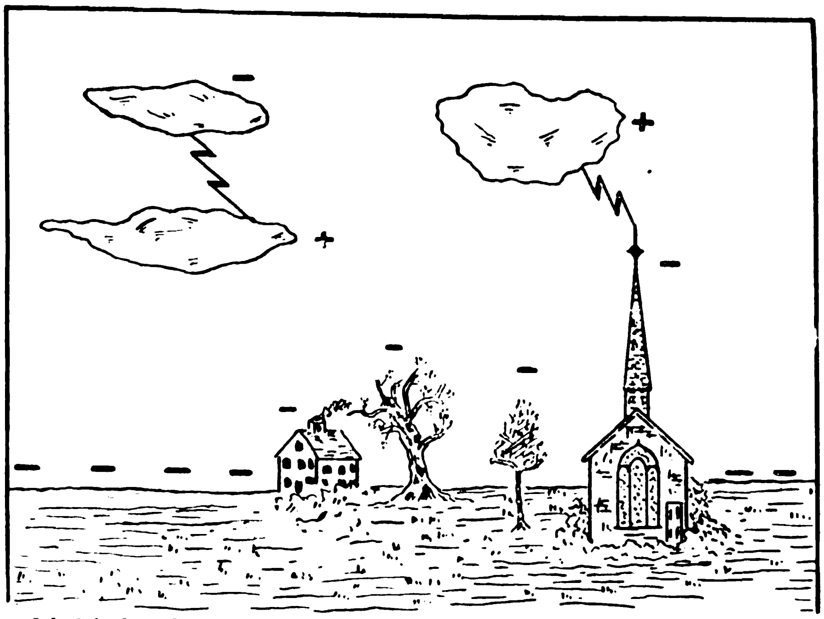
center of a well-varnished cork inserted in the mouth of the beaker. When positive electricity enters the knob, the inner tinfoil coating is charged. The outer tinfoil coating is acted upon by induction and its inner surface becomes negative and its outer surface positive. The outer surface can be touched with the finger and the free positive removed. As the jar now stands it contains positive inside and negative outside. The two plates show the same effect and merely represent the two tinfoil coatings in a different position. When the free position is removed in this case, one piece of foil will be positive and the other on its inner surface negative. In this manner electricity is condensed as the expression goes, but in science the explanation is more definite and it is said that *the potential is raised*.

Principle of the Condenser.—If a closed tank with one inlet is pumped full of gas, the gas pressure rises. The gas may enter in small quantities until the tank exercises as much pressure as the pump, then the action ceases. A condenser is an electrical tank in which the electrical pressure rises as more electricity enters. The correct expression is that the potential rises as the condenser is charged. In order to be accurate, and thus have a system by which measurements can be made, the units of potential and capacity are defined with reference to the condenser as follows:

Definition of the Farad.—A condenser has a capacity of one farad, if, when charged with one coulomb of electricity it has a difference of potential of 1 volt. This means, for instance, that if a metal tank takes in a cubic foot of air and then shows 15 pounds pressure, the tank has a capacity of 1 cubic foot. In the same sense if the electrical tank takes in a coulomb and shows 1 volt, its capacity is 1 farad. The capacity is determined by the pressure developed by a certain quantity of electricity in the condenser. This is expressed by the simple formula: Quantity = pressure × capacity. For instance, if a condenser had a capacity of 1 farad it would have 1 volt difference of potential with 1 coulomb, 2 volts with 2 coulombs, 3 volts with 3 coulombs, etc. The idea is relatively the same as if 1 cubic foot of air is forced into a tank of 1 cubic foot, the pressure will be 15 pounds; with 2 cubic feet, 30 pounds; with 3 cubic feet, 45 pounds, etc.

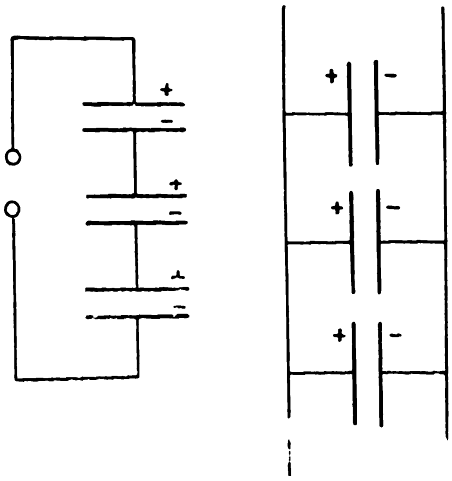
When sheets of tinfoil and paraffined paper are arranged in alternate layers, and a tongue of tinfoil allowed to project for the purpose of making connections from each tinfoil sheet, but in such a manner that they project so that all the positive sheets are easily connected together and all the negative sheets, as shown, then a practical condenser is ob-

tained which can be used for exact tests when its capacity has been determined. The farad is such a large unit and so unattainable in practice that condensers are built on the basis of one one-millionth of a farad. This fractional part of the original unit is called a microfarad. A condenser of a microfarad capacity is about the size of a cigar box, but, of course, such a comparison is not very exact, because the capacity of a condenser depends upon the area of the tinfoil sheets, the nature of the dielectric and the thickness of it.



How Lightning Takes Place, Through Induction Between Cloud and Cloud or Cloud and Earth.

Connecting up Condensers.—Condensers may be connected in series for high potential effects and in multiple for low potential effects. By this is meant that condensers in series give pressure and small quantity, while those in multiple give large quantity and little pressure. This idea is represented by the following diagrams: Here the + and — poles are



Condensers Connected in Series and in Multiple.

connected together and by that means the potentials of the various condensers. In the other sketch all the positive poles of the condensers are connected together and all the negative. The manner of getting at the total capacities is very readily shown.

Condensers in Multiple.—Add the capacities of the various condensers together; for instance, if they are 1, 2 and 3 farads capacity, respectively, the total would be 6 farads.

Condensers in series.—The rule in this case is rather more difficult to grasp. It states that "the total capacity of condensers in series is equal to the reciprocal of the sum of the reciprocal of the capacities." Turned into arithmetic it appears as follows:

$$\text{Total capacity} = 1 \div \frac{1}{\text{capacity of 1st condenser}} + \frac{1}{\text{capacity of 2d condenser}} \div \frac{1}{\text{capacity of 3rd condenser}}$$

carried out to any number of condensers. In the case presented the total capacity would be where 1, 2, and 3 farads are in series:

$$\frac{1}{\frac{1}{1}+\frac{1}{2}+\frac{1}{3}} = \frac{1}{\frac{11}{6}} = \frac{6}{11} \text{ of a farad.}$$

Interesting examples of condenser action are afforded by a thunder storm. In this case the action may be merely between clouds. One bank heavily charged with + and the other with negative electricity. When they approach, the clouds develop a high potential at the points nearest to each other, and the air resistance is broken down by a blinding flash. When a condenser is discharged by a wire leading from one pole to the other the principle is the same. If the electrified cloud is over a church steeple or a high tree, induction takes place. If the cloud is positive, the high structures underneath, and, in fact, the whole area exposed, become negatively charged. When the strain becomes so great that the inductive influence breaks down the integrity of the resistance between, what is called lightning appears; and on its track, as a natural consequence of the rift in the air, the thunder follows. Lightning is practically instantaneous as far as the eye is concerned. Thunder, however, travels at the rate of 1,100 feet per second, or about 1 mile every 5 seconds. By noting the number of seconds between the flash and the thunder a fair estimate of the distance at which the disruptive discharge took place can be obtained.

Cause of Disruption of Materials.—It is interesting to know the cause of the so-called splitting and breaking effects of lightning. If a tube is filled completely with water and sealed and exposed to a static discharge of sufficient force it will break into pieces. This is due to the steam and gases of decomposition produced by the electricity in passing. The induction between the water inside, and the charge outside also breaks down the glass wall between. With a tree, however, the wood cells contain moisture which is suddenly transformed into high pressure steam when the lightning passes. The effect of this is an internal disruption similar to a series of miniature boiler explosions, and the tree is necessarily split in two.

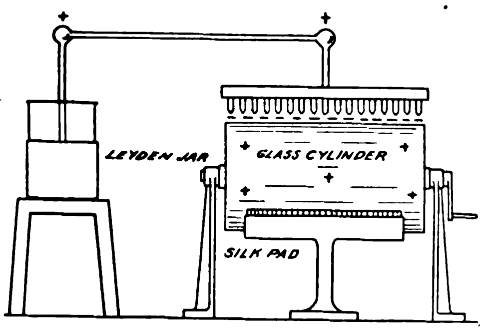
Waves Produced by Condensers.—When a Leyden jar or a condenser is discharged it produces a tremendous disturbance in the ether. This disturbance appears in the form of waves, known by the name of Hertzian waves, and their application for the transmission of intelligence without wires is known as wireless telegraphy.

If a large Leyden jar, or a static machine, is allowed to produce a series of discharges in the center of a room, it can be proven that millions of waves are set into motion in the room, pass through the walls and reach out over miles of distance through all sorts of obstacles such as other buildings, hills, etc.

Wireless Telegraphy.—A wire stretched around the room with fine saw cuts in it, thus dividing it up into sections, will exhibit small sparks between the edges of the cuts when a Leyden jar is discharged as described. This is due to the waves striking the wire, producing electricity in it, and appearing as minute sparks in a

darkened room. Carrying out the idea with a sheet of tinfoil on a glass plate, the tinfoil divided by fine saw cuts, provides a device by which waves can be detected still further away. It is but a step to inclose fine metal filings in a glass tube with a metal plug at each end. This will detect waves at a great distance away from their source and if used in conjunction with a few cells of battery a telegraphic relay and sounder comprises the essential elements now in use for wireless telegraphy.

Frictional and Induction Machines.—Machines producing static electricity may be divided into two classes—frictional and induction machines. The first type is practically unknown in the laboratory but consists of a cylinder of hard rubber



A Frictional Machine with Outside Charge Obtained by Induction Through Points.

or glass rotated against a buffer or rubber of flannel, wool or silk. A metal rod is placed near with teeth mounted in it almost touching the cylinder. Rotation of the cylinder produces + electricity on its surface as it is rubbed by the pad. The teeth or points of the rod blow bound − on the glass, and, in consequence, an equal amount of free + is collected by the Leyden jar. This constitutes the so-called frictional machine in which, as can be seen, induction is an important factor.

If the cylinder is replaced by a device which has its charge reinforced by *induction* alone, then the pure type of induction machine appears as represented by those machines bearing the name of Holtz, Toepler Holtz, Ranney, Wimshurst, etc.

An interesting feature of induction and frictional machines is the fact that toothed rods keep the surface of the glass plate or cylinder neutralized. For instance, in the case given, as the glass cylinder rotates, the excited surface of the glass is brought opposite the row of teeth, which blow a stream of negatively charged particles of air on the retreating portion of the cylinder. This neutralizes it before it passes under the silk pad again.

Action of Points.—It must be understood that the action of a point is to discharge electricity. The air particles in contact are charged and repelled, and as this is a continuous action it is evident that by this process the charge of a pointed object is quickly dissipated unless as rapidly supplied.

CALCIUM CARBIDE AS A RESISTANCE MATERIAL.

A new resistance material for electric heating apparatus or metallurgical furnaces has recently been proposed by Dr. O. Frohlich, of Berlin. Up to the present resistances for this purpose have belonged to one of four kinds: isolated metallic wires or thin metal sheets; artificial carbon resistances; mixtures of finely divided carbon or metal compressed along with substances which, when cold, have very slight conducting properties; and artificial carbons also having the characteristic of bad conductance when cold. Metallic resistances of the first kind need not be considered for industrial purposes, and those of the second kind, besides having to be covered with a coating of glaze, have so low a specific resistance that they can hardly be employed on circuits of over 100 volts. Composite resistances of the third class have the disadvantage that the relative specific resistance of the constituents when hot and cold are now uniform, and there is a great tendency for the formation of cracks due to unequal expansion. Further, in order that the substance may permit the passage of current when cold, it must contain continuous veins of conducting material, amounting to about 20 per cent. of the whole, and this reduces the resistance so much that it becomes unsuitable for industrial voltages, at least on apparatus of any considerable size. The formation of a crack may also render it useless on account of the non-homogeneity of the material. The employment of resistances of the fourth class necessitates some method of warming by extraneous heat before sufficient current can pass to maintain the temperature, and this is a serious hindrance to their usefulness. Dr. Frohlich proposes to avoid most of the faults, inherent in the systems mentioned above, by employing as resistances cast homogeneous substances conducting when cold. There is then no need for initial warming, and the heating by the current takes place uniformly. If a crack appears it may be remedied by inserting a piece of carbon so as to short-circuit. When current is then passed, the points in contact with the carbon melt, and the adjacent sides of the crack unite. The conductivity of the material must be low so as to allow of the application of common industrial voltages. This is not the case with the cold conducting bodies employed hitherto, but carbide of calcium fulfills the conditions required. Its conductivity when cold is low, but has been proved not to be dependent upon the presence of particles of pure carbon, and its resistance when hot is sufficient for the purpose required. Resistances of calcium carbide can be made in the electric furnace by inserting the contact-pieces in a bath separated by a quantity of the resistance material. Between the contact-pieces and the carbide pieces of carbon are tightly packed, which fuse, when current is passed, and the whole becomes a homogeneous mass, which may be transferred to any mould desired. The resistances may be heated by the current until the interior becomes soft or even fluid, though it is best to make them of a flat form by dividing the liquid material by means of plates of some substance not attacked by melted carbide.—"Engineering."

TELEPHONY AT ST. LOUIS.

BY P. KERR HIGGINS.

One cannot but be supprised at the small attendance so noticeable in the Palace of Electricity at the World's Fair, considering the popularity and general knowledge of the science by the public. I believe this can be remedied in great measure by opening the Palace of Electricity in the evening, say between 6 and 9 o'clock, even if necessary to close it in the afternoon. It is in the evening that the Palace would show to best advantage, and in this way the people's attention would be drawn to it as it could be in no other manner.

The telephone exhibits in the Palace received more than their share of patronage, but many of them are not displayed to advantage, either as regards location or annoucement. Particularly unfortunate in this respect may be mentioned the Faller Automatic and the exhibit of the Independent Telephone Operators. These exhibits deserve a better location. In the case of the Faller Automatic, the company has installed a fairly good exhibit, but it lacks publicity, myself and others having difficulty in locating it. This is to be regretted, as it is very interesting and instructive and one which every telephone man should visit.

The exhibits as a whole are good, some exceptionally good. The Bell Company has put forth an extra effort, and has certainly put up the most attractive, if

not the best exhibit in this department. It might have been well, however, had it kept out of the automatic business if the samples shown are to be taken as a criterion of what it can do along this line. Had there been no other automaic exhibits, what the Bell Company shows might have proved interesting and instructive, but placed alongside of the Strowger and Faller it seems like a toy.

While not strictly on telephone lines, the telephone visitor should by all means take in the De Forest and other wireless telegraph exhibits. The De Forest system is shown in all its details and no expense has been spared to make it both ornamental and useful.

Among the first things one sees on entering the grounds is the De Forest observation tower, 300 feet high, which is much patronized and proves a great advertisement, many people recommending the view from the "De Forest Tower." It is located at the entrance of the Orleans Plaza, and is equipped with two elevators. Branch offices of this company are located in several of the prominent buildings and in the grounds. Messages can be sent to Chicago, a distance of 250 miles, through a relay station at Springfield, Ill.

The telephone exhibits are divided into four classes: Manual, Automatic, Local Battery Telephones and Auxiliary Apparatus. Of the first class the Kellogg and Bell are the exponents, of the second the Strowger Automatic, the Faller Automatic and the Bell. The exhibits of the Bell Company show few, if any, features new and interesting to telephone men, but that company has put up an exhibit for the people which is very attractive, the location is ideal and the trimmings white predominating, attract the attention as probably no other exhibit does. A nine position board fully equipped and central energy is constantly in use together with power board, protectors and cross connecting racks. Long distance booths are provided for the use of the public. In a glass case is shown the development of the telephone by means of models and original apparatus which is very instructive and interesting to the public. There are also samples of Mining and Farmers' telephones shown together, with a poor effort at automatic telephony. The whole exhibit is well laid out and each and every item is shown to advantage, which cannot be said of many of the other exhibits. As a side show, the American Bell Company is exhibiting what can be done in the way of wireless telephony on a ray (or beam) of light. No effort is made to talk over this, but at regular intervals a bugle is blown at the distant end and one is invited to listen. If one did not know the facts he would be inclined to doubt the whole thing as the sound is almost inaudible, and all the exhibit, while interesting, is hardly worth the expense, no one is satisfied after hearing it. On a large card the public is told how this telephoning without wires is done. The stations are about 400 feet apart. The receiver at the receiving end is in circuit with a battery and a selenium cell which is placed in focus of the light beam (arc light.)

The Kinloch Company of St. Louis has a combined display with that of the Kellogg and is probably the most up-to-date manual exhibit at the exposition. It is a 12 position board full central energy, having 10 operators in attendance, one monitor and chief combined, booths, a very complete Kellogg power board and main and intermediate rack. The lines extend all over the grounds with trunks to main office. The power equipment is in duplicate and the whole exhibit makes a very fine model exchange.

The 4-party line (Harmonic system) is in use and gives satisfaction, four different colored buttons being provided for each cord circuit and on being depressed remain so until another button on the same set is used. The display of the Kellogg apparatus in addition to this shows private branch and branch exchange boards of almost any size and style one might call for, together with toll boards fully equipped including calculagraphs. Nearly a score of such boards are on the floor for the inspection of the public. A souvenir in the shape of a safety (or puzzle) purse is given to visitors. The writer was unfortunate enough not to know this till he visited the factory at Chicago a week later. In a separate room is shown the methods of insulating wire. All of the exhibit reflects great credit on the Kellogg Company and certainly saves the reputation of the Independents from the manual standpoint. Another wireless telephone exhibition on more practical lines, being that of induction, is shown in the court of the Palace and talks over a distance of about 250 feet with good results, but is not commercially practical although interesting and instructive.

The best exhibit in the second section is that of the Strowger Automatic (Automatic Electric Company) which has the best location and its exhibit is very complete and well patronized. All the latest improvements are shown including the bridging system which has superseded the series system with its many drawbacks and the combination of a connector and selector for private branch exchanges. The exhibit occupies about 2,000 square feet, has instruments of all kinds, two switchboards of selectors, two booths, wire chief and toll desk, combined power and tell-tale board, power machines, Cook distributing board and protectors, the power and ringing machines are in duplicate. A service is rendered for the Jefferson Guards and the public all over the buildings. The apparatus of the Strowger is so well known that it is hardly necessary to enter into detail as to its working. The entire exhibit is handsomely furnished and every convenience provided for the public and is a credit to the Automatic Electric Company. The Faller Automatic Company is badly located, which is to be regretted, as it has made special efforts at great expense to show telephone men and the public in general a very meritorious invention. There are shown two sections of board of 200 lines each, a power board and apparatus and six selectors. This whole exhibit is under the charge of Mr. Medhurst and Mr. Kneiser, who take pleasure in showing the public the many interesting features of its system. The Faller system not now being in use at any exchange, it might prove interesting to give a few of its leading features.

The object of the Faller was in the shape of a reformation in manual practice and was intended to replace the multiple feature, which it does. It is then virtually an automatic transfer system. By dispensing with the multiple the increasing expense of telephone switchboard installations was done away with. In addition to this the operating expenses were reduced one-half, as one operator (a deaf mute at that) can easily take care of 200 lines. It also dispenses with the disagreeable features of operators conversing with subscribers, making mistakes and being impertinent. The operator on this system never talks to the subscriber but simply goes through the motions indicated by the apparatus. There is therefore no operators' talking circuit provided. No change in substation equipment is necessary other than a little extra wiring and the addition of a "signal box." The system is central energy The Faller people have some features which are better than the Strowger, namely, the fact that all numbers can be used from 0 up as high at one may wish, it only being a question of the number of trunks necessary. Another is the fact that the subscriber makes up his number and if a mistake is made he can correct it before turning in the call. Information

pegs are unnecessary, as the call is direct it is also under the control of the operator all the time. False busy tests are impossible, also double connections, the average time of call after turning in is four seconds until called subscriber's bell is rung. It is not necessary to push a button to ring your party which the subscriber to the Strowger so frequently forgets. All selectors are interchangeable as in the Strowger. There is also provided an emergency button for advising the wire chief if line is out of order.

It appears from the literature freely circulated by the Faller people, that up to 1,000 lines the apparatus is more expensive than the manual, but after that increases very slowly as against a large increase in the multiple. This is the cost per line, the maintenance and operating is always less and the service quicker and more reliable. This system is in reality a go-between the manual and full automatic and while it does not fit into the place of the full automatic it has a wide field of usefulness. The system is called a "semi-automatic," but it is in reality an automatic transfer system. It is a step in the right direction as it eliminates the faults due to the faulty articulation on the part of the subscriber, and also the liability of the operator selecting a wrong jack. As previously stated, each section consists of 200 lines terminating on one jack (no multiple). Jacks, keys, cords and plugs are used as in standard manual practice. The number is sent in electromechanically by the device called the sender. This signaling outfit is divided automatically into groups, the first corresponding to the local section and the last to his number in that section, no effort on the part of the operator is necessary as all movements are indicated by lamps so that the operator only follows the indicated lamp; double supervision and positive disconnect signals are provided; no change is made in the talking circuits of the subscribers. The switchboard does not materially differ from the ordinary 100 line position, the lower part has the answering jacks and the upper the trunks. Two lamps are provided for each jack, a white lamp for the line and a red one for the line indicating lamp.

The trunking panels are equal to 1 per cent. of the full capacity of the system; above the trunk jacks is the trunk indicating lamp common to all jacks of that group. Two keys are provided for each cord circuit and three plugs, the answering, trunking and calling plug. Three lamps are provided for each cord circuit, the disconnect lamp, indicating and supervision. Six selectors are provided for each section which control the lamps, a trunk-busy test lamp is provided for each section, a relay is provided in each subscriber's line whose function is to light the line lamps and line pilot as in manual practice.

When the subscriber turns the knob on the signal box (after setting up the number wanted), his line becomes grounded, allowing current to flow through relay and lighting the line lamp; operator plugs in jack with answering plug then raises the corresponding trunk plug. This act automatically operates a key, thereby lighting the trunk indicating lamp; the operator then tests for busy (in usual manner), the busy lamp lighting if line is busy, the plug is inserted in the first jack (of group indicated), not busy. This act tranfers the call to the local section of called subscriber, the second operator pulls selector key corresponding to signals (or lights) received, which lights the red line indicating lamp of called subscriber, inserts plug and rings party wanted. The supervisory lamps show the condition of the connection in the usual manner. The act of disconnection, by the second operator, gives a signal to the originating position and all apparatus is restored to normal. The movements are simple and quicker than they can be described, but there is much room for improvement especially in the line of providing automatic disconnection which, I believe, will eventually be done. Other little details could be improved which would make the service most desirable and efficient. It is possible to give party line service on this system, which in some exchanges is considered absolutely necessary, also pay station, toll and measured service. The service like full automatic is strictly private.

The Faller people are making a great mistake in charging a royalty for their apparatus. The day of royalties in the telephone business is past, and the Independents will not stand for it. Such methods will retard its adoption.

The third class is represented by such well-known firms as the Sumter Telephone Manufacturing Company, Central Telephone & Electric Company, and others, all of whom have elegant displays of almost everything in different styles of sub-station equipment and local battery or toll line switchboard equipment. The fourth class is represented by the American Electric Fuse Company with a full line of protectors, the American Conduit Company, the Lelande Battery Company, Strombaugh Anchor Company, Western Electrical Company, National Carbon Company, Electric Storage Battery Company and the Controller Company; the latter has now added to its fine line of controllers a coin box for operation in conjunction with the automatic service, which shows it is progressive and up-to-date. The Standard Underground Cable Company shows a complete exhibit of underground work. In addition to this is what might have been the most interesting and instructive exhibit of all, that of the Independent Operators, showing the progress of Independent telephony up to the modern "Adjustaphone," which is shown as the latest device. The exhibit shows acoustic, magneto, arm rest, and a miscellaneous collection of switchboards and telephones of all kinds, including the evolution of the glass insulator shown by the Munsey Glass Company.

Great credit is due Messrs. Wasson, Hubbard and others, for the labor and expense they were put to in making this display for the benefit of the public, and it is to be regretted that the individual parts were not scattered more and set off to better advantage by being placed in glass show cases. Had such been done it would have attracted more attention. There should also have been some one in attendance provided with literature showing what the Independents have done, even as the older company is providing each visitor with books and pamphlets showing its marvelous growth.

The books issued by the Bell Company are "Statistics," showing:

Number of subscribers in the United States.

Ratio of subscribers to population in the United States.

Average daily messages in the United States.

Average toll messages in the United States.

Average messages per inhabitant in the United States.

Total miles of wire in use (telephone).

Total miles of toll lines.

Total miles of pole lines.

Total miles of underground cables.

Total number of employes.

Comparison of European and American statistics.

Comparison of telegraph, telephone and mail.

Number of cities and villages connected, also a book showing the development of the switchboard, and other cards, etc.

Lack of organization on the part of the Independents is probably the cause for the poor display and it is hoped that with the organizations now being consummated, a better representation of the In-

dependent cause will be forthcoming at future expositions, if for no other reason than to post the intelligent and thoughtful public as to the wonderful growth of the Independent movement.

THE TELEGRAPHIC TRANSMISSION OF PHOTOGRAPHS.*

Many more or less successful attempts have been made in recent years to devise a method of reproducing photographs, drawings and handwriting at a distance by means of electricity. The selenium cell, the action of light upon which diminishes or increases its resisting properties, afforded a ready means of transmitting fluctuations in the intensity of a source of illumination, and of converting these differences of light intensity into the oscillations of an electric current.

If, for example, a beam of light and a selenium cell be simultaneously passed over the opposite surfaces of a photographic negative, varying degrees of opacity of the plate will set up corresponding oscillations of the current in the circuit of the cell. This is the common feature of all the transmitting devices hitherto suggested.

The current oscillations are made to act on a receiving apparatus which will convert them into fluctuations of light intensity. The design of the receiving apparatus has, however, so far been the weak point in all these systems, because the electric currents transmitted are so very feeble. Furthermore, the synchronous working of the transmitting and receiving apparatus has been a source of difficulty, and but imperfectly secured in previous forms of apparatus. This does not, however, appear to be the case with the teleoptical system of Prof. Arthur Korn, of Munich, whose success is due principally to the employment of a vacuum tube as an adjustable source of light at the receiving station.

While engaged in investigating the radiations given off by the electrodes of a vacuum tube exhausted to a pressure ranging between 0.2 and 2 mm. Prof. Korn noticed, as Hertzian vibrations were applied to the electrode, the extreme sensitiveness with which these radiations would react on small alterations in the circuit. The sensitiveness suggested a possible utilization of those radiations which were photographically most efficient, in connection with a method of electrical telephotography.

The essential feature of the apparatus employed may be gathered from the general diagram, Fig. 1. A sensitive photographic film wound round the cylinder of the receiver rotates in front of a small opening, c, (0.25 mm. × 0.25) in a

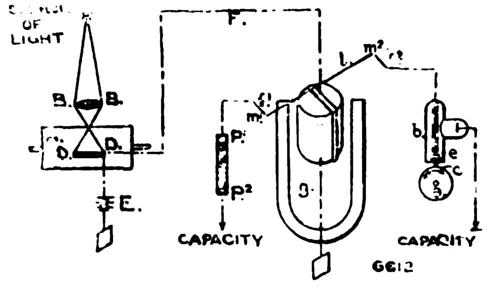


Fig. 1.—Diagram Showing the Arrangement of Prof. Korn's Teleoptical System.

vacuum tube, b, the surface of which is coated with black paper and tinfoil. By means of high frequency currents, luminous radiations are produced inside the tube, which, after passing through the small opening, act on the sensitive film in a spiral line exactly like the stylus of a phonograph.

The roller is moved synchronously with the glass cylinder of the sending apparatus A, on which is wound a film bearing the photograph to be transmitted, on which is directed a concencrated beam of light, B, C, D, from a Nernst lamp. The beam of light penetrates the film and strikes a selenium cell D, placed inside the cylinder. According to the different shades in the photograph to be transmitted, the selenium cell will receive more or less light, by which its resistance is raised or lowered; while an electric current from an accumulator, which is connected up in series with the cell and the conductor F, will undergo corresponding variations of intensity, thereby regulating the intensity of the light radiations of the receiving tube. The light from the tube being regulated by the current according to the depth of shade of the

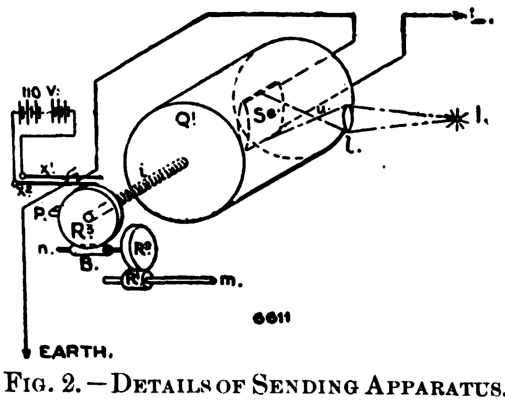


Fig. 2.—Details of Sending Apparatus.

film at the sending station, a corresponding image will be produced. This is provided for in the following way: The active electrode, e, of the tube being connected to one of the poles, P, of the secondary coil of a Tesla apparatus, by inserting fields of sparks formed by the points m^1, m^2 of a galvanometer needle, l, and two fixed points f^1, f^2, the intensity of the radiation given off by the tube will vary according to the distances m^1, f^1 and m^2, f^2, which again vary according to the strength of the current transmitted through the galvanometer g.

Now as to the details of the different parts of the apparatus, a diagrammatic view of the sending apparatus is shown in Fig. 2. The photograph to be transmitted in the shape of a transparent film is wound on the glass cylinder Q^1, which is made to rotate by means of an electromotor and a worm gearing (R^1, R^2, BR^1); one revolution being made in from 20 seconds to $\frac{1}{20}$th of a second, during which the cylinder is displaced by 1 mm. in the direction of its axis which is fitted with the screw i. The dimensions at present used are:

Diameter of glass cylinder... 8 cm.
Length of glass cylinder..... 20 cm.
Length of screw in the axis.. 15 cm.
Length of the film...... 9 to 12 cm.

From the illuminant J, which is a 64

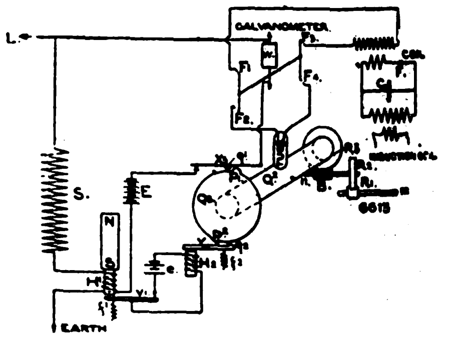


Fig. 3.—Details of the Receiving Apparatus.

cp. Nernst lamp, the light passes through the lens to a point u, of the film, and, after penetrating through the glass cylinder, strikes the selenium cell Se which is rigidly mounted in the interior of the cylinder.

The details of the receiver are shown in Fig. 3. The roller Q^2 is rotated through the worm gearing R_1, R_2, BR_1, by means of an electromotor. The speed of the latter is so controlled as to be 1 per cent. greater than that of the transmitting motor, and the roller Q^2 after each rotation, is stopped by means of the lever q_2, until the synchronism signal arrives from the sender. Along the roller Q^2, which is 2 cm. in diameter and 12 cm. in length, a small vacuum tube is made to travel $\frac{1}{4}$ mm. per second in a direction parallel to the tube itself, the beam of light from the tube thus describing a spiral line of small pitch. The varying intensity of the beam of light depends, as before mentioned, on that of the original

* From the "Engineering Review," London.

at the sending end, hence there is reproduced on the sensitive film a duplicate of the original with a reduction in size by 1 : 4.

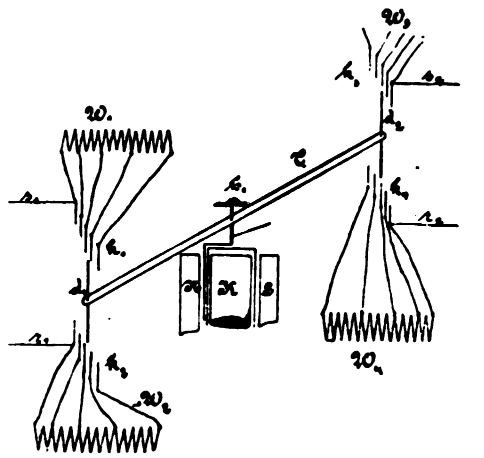


FIG. 4.—RHEOSTAT APPARATUS IN THE TESLA COIL CIRCUIT WHICH IS NOW USED INSTEAD OF THE SPARK GRADUATION.

Instead of the spark graduation above described, the inventor now obtains the variation in the value of the current by means of resistances inserted in the circuit of the Tesla coil (see Fig. 4). The

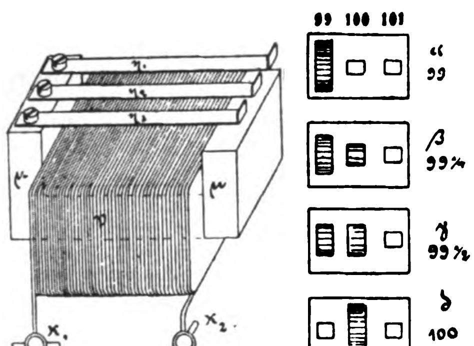


FIG. 5.—HARTMANN-KAMPF FREQUENCY INDICATOR.

needles d_1, d_2, slide along the four combs, k_1, k_2, k_3, k_4, which are constructed of thin mica and metal plates, ¼ mm. in thickness, superposed and compressed; the resistances w_1, and w_2, w_3, w_4, being

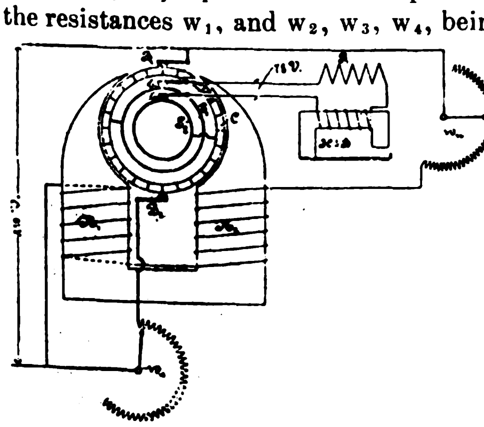


FIG. 6.—DETAILS OF SPEED REGULATOR CONNECTIONS.

inserted between the various pairs of metal plates. In the figure only five metal plates are shown for each comb, whereas in the actual arrangment used by Prof. Korn, 26 plates are being used, the total length of the comb being about 16 mm. Prof. Korn thinks, however, 10 metal plates to be quite sufficient. The wires s_1, s_2, connect with the poles of the Tesla coil, and the wires r_1, r_2, with the tube. The combs are mounted on indiarubber insulating supports, while the resistances w are placed in special boxes.

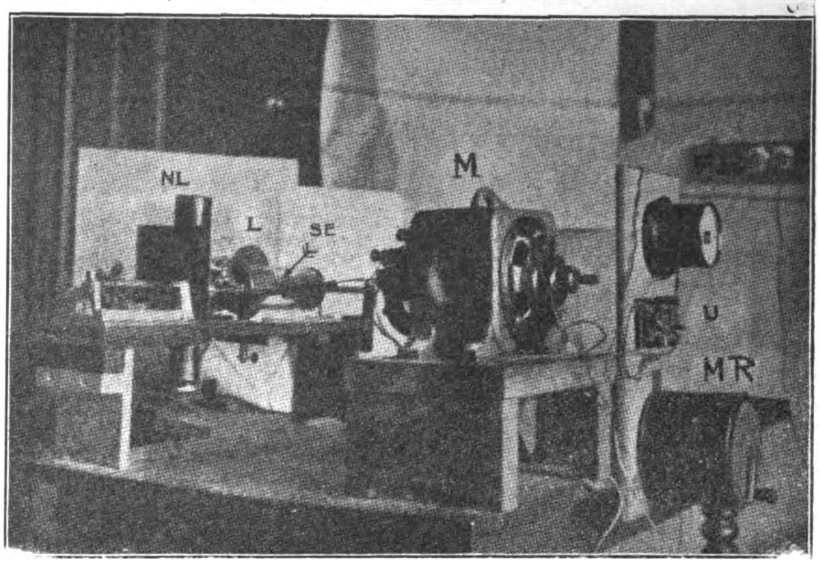


FIG. 2A.—VIEW OF THE SENDING APPARATUS.
FB—Frequency Indicator. L—Lens. M—Electromotor. MR—Motor Regulator. NL—Nernst Lamp. SE—Selenium Cell. U—Switch.

The transmission of a photograph of 9 × 16 cm. requires just 30 min. with the speed of roller at present used, the limiting factors being the inertia of the selenium in the transmitter and the inertia of the galvanometer in the receiver.

In order to compensate for possible errors due to the inertia of the selenium, the space left free on the sender roller is used for inserting a uniformly illuminated film-strip serving to check the working of the selenium. If any error be noted, the sensitiveness of the galvanometer has to be altered accordingly.

Special care has been bestowed by Prof. Korn on the design of the apparatus for securing the synchronous rotation of the rollers. As it is quite impossible to obtain absolute synchronism, the unavoidable small errors occurring have to be compensated for at reasonable intervals, so as to prevent them from becoming appreciable. Continuous current ½ hp. shunt-wound motors are used for obtaining a uniform rotation of the cylinders, current being supplied from accumulators. For measuring and adjusting the proper speed, one of the motors is fitted with collector rings for alternating-current supply, the latter being led on to a Hartmann-Kampf frequency indicator. This (Fig. 5) is based on the principle that, out of a series of tuned springs, the one whose period is in resonance with the period of the alternating current will be caused to vibrate by an electromagnet excited with the current. In Fig. 5, η_1, η_2, η_3, represent three such springs having the period of 99, 100 and 101 respectively, K_1 and K_2 being the terminals connecting to the alternating current that traverses the coil v round the iron core μ consisting of transformer plates. In α, β, γ, δ, a front view of the spring in the actuated state is shown for the period 99, 99¼, 99½ and 100 respectively. In Fig. 6 the connections for the speed regulator are shown diagrammatically. B_1 B_2 are the continuous current brushes, C the commutator, S_1 S_2 the collecting rings, b_1 b_2 the brushes intended for collecting alternating current, R a shunt resistance for the frequency indicator H and B, w_a, the starting resistance of the motor, and w_n, the regulating resistance of the shunt.

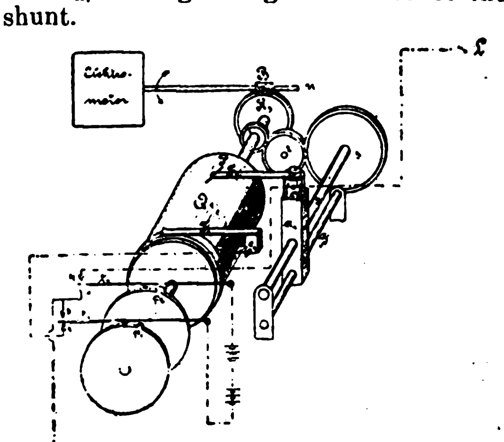


FIG. 7.—SENDING DEVICE FOR TRANSMITTING HANDWRITING.

In order to simplify the necessary corrections for the errors in synchronism, the speeds of the motors at the two stations are arranged to differ from one another. At the sending station the fre-

dependent cause will be forthcoming at future expositions, if for no other reason than to post the intelligent and thoughtful public as to the wonderful growth of the Independent movement.

THE TELEGRAPHIC TRANSMISSION OF PHOTOGRAPHS.*

Many more or less successful attempts have been made in recent years to devise a method of reproducing photographs, drawings and handwriting at a distance by means of electricity. The selenium cell, the action of light upon which diminishes or increases its resisting properties, afforded a ready means of transmitting fluctuations in the intensity of a source of illumination, and of converting these differences of light intensity into the oscillations of an electric current.

If, for example, a beam of light and a selenium cell be simultaneously passed over the opposite surfaces of a photographic negative, varying degrees of opacity of the plate will set up corresponding oscillations of the current in the circuit of the cell. This is the common feature of all the transmitting devices hitherto suggested.

The current oscillations are made to act on a receiving apparatus which will convert them into fluctuations of light intensity. The design of the receiving apparatus has, however, so far been the weak point in all these systems, because the electric currents transmitted are so very feeble. Furthermore, the synchronous working of the transmitting and receiving apparatus has been a source of difficulty, and but imperfectly secured in previous forms of apparatus. This does not, however, appear to be the case with the teleoptical system of Prof. Arthur Korn, of Munich, whose success is due principally to the employment of a vacuum tube as an adjustable source of light at the receiving station.

While engaged in investigating the radiations given off by the electrodes of a vacuum tube exhausted to a pressure ranging between 0.2 and 2 mm. Prof. Korn noticed, as Hertzian vibrations were applied to the electrode, the extreme sensitiveness with which these radiations would react on small alterations in the circuit. The sensitiveness suggested a possible utilization of those radiations which were photographically most efficient, in connection with a method of electrical telephotography.

The essential feature of the apparatus employed may be gathered from the general diagram, Fig. 1. A sensitive photographic film wound round the cylinder of the receiver rotates in front of a small opening, c, (0.25 mm. × 0.25) in a

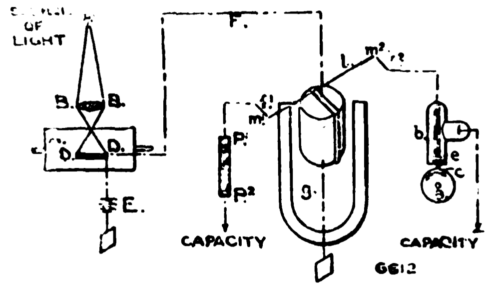


Fig. 1.—Diagram Showing the Arrangement of Prof. Korn's Teleoptical System.

vacuum tube, b, the surface of which is coated with black paper and tinfoil. By means of high frequency currents, luminous radiations are produced inside the tube, which, after passing through the small opening, act on the sensitive film in a spiral line exactly like the stylus of a phonograph.

The roller is moved synchronously with the glass cylinder of the sending apparatus A, on which is wound a film bearing the photograph to be transmitted, on which is directed a concencrated beam of light, B, C, D, from a Nernst lamp. The beam of light penetrates the film and strikes a selenium cell D, placed inside the cylinder. According to the different shades in the photograph to be transmitted, the selenium cell will receive more or less light, by which its resistance is raised or lowered; while an electric current from an accumulator, which is connected up in series with the cell and the conductor F, will undergo corresponding variations of intensity, thereby regulating the intensity of the light radiations of the receiving tube. The light from the tube being regulated by the current according to the depth of shade of the

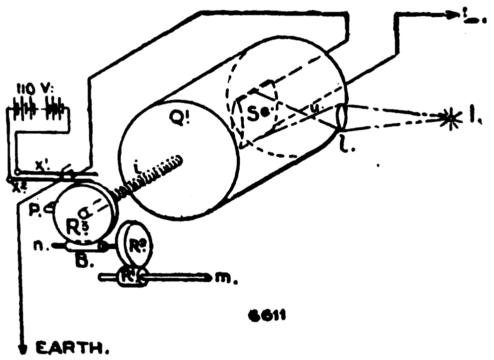


Fig. 2.—Details of Sending Apparatus.

film at the sending station, a corresponding image will be produced. This is provided for in the following way: The active electrode, e, of the tube being connected to one of the poles, P, of the secondary coil of a Tesla apparatus, by inserting fields of sparks formed by the points m^1, m^2 of a galvanometer needle, l, and two fixed points f^1, f^2, the intensity of the radiation given off by the tube will vary according to the distances m^1, f^1 and m^2, f^2, which again vary according to the strength of the current transmitted through the galvanometer g.

Now as to the details of the different parts of the apparatus, a diagrammatic view of the sending apparatus is shown in Fig. 2. The photograph to be transmitted in the shape of a transparent film is wound on the glass cylinder Q^1, which is made to rotate by means of an electromotor and a worm gearing (R^1, R^2, BR^3); one revolution being made in from 20 seconds to $\frac{1}{20}$th of a second, during which the cylinder is displaced by 1 mm. in the direction of its axis which is fitted with the screw i. The dimensions at present used are:

Diameter of glass cylinder... 8 cm.
Length of glass cylinder..... 20 cm.
Length of screw in the axis.. 15 cm.
Length of the film...... 9 to 12 cm.

From the illuminant J, which is a 64

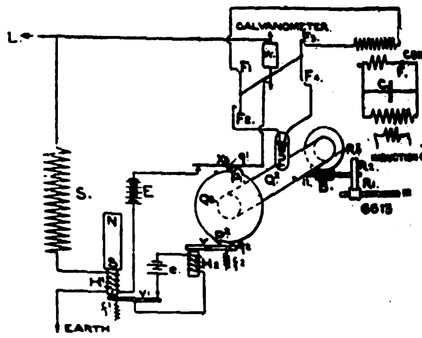


Fig. 3.—Details of the Receiving Apparatus.

cp. Nernst lamp, the light passes through the lens to a point u, of the film, and, after penetrating through the glass cylinder, strikes the selenium cell Se which is rigidly mounted in the interior of the cylinder.

The details of the receiver are shown in Fig. 3. The roller Q^2 is rotated through the worm gearing R_1, R_2, BR_3, by means of an electromotor. The speed of the latter is so controlled as to be 1 per cent. greater than that of the transmitting motor, and the roller Q^2 after each rotation, is stopped by means of the lever q_2, until the synchronism signal arrives from the sender. Along the roller Q^2, which is 2 cm. in diameter and 12 cm. in length, a small vacuum tube is made to travel $\frac{1}{4}$ mm. per second in a direction parallel to the tube itself, the beam of light from the tube thus describing a spiral line of small pitch. The varying intensity of the beam of light depends, as before mentioned, on that of the original

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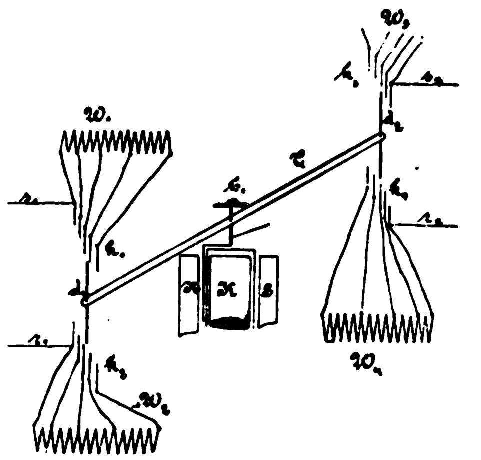


FIG. 4.—RHEOSTAT APPARATUS IN THE TESLA COIL CIRCUIT WHICH IS NOW USED INSTEAD OF THE SPARK GRADUATION.

Instead of the spark graduation above described, the inventor now obtains the variation in the value of the current by means of resistances inserted in the circuit of the Tesla coil (see Fig. 4). The

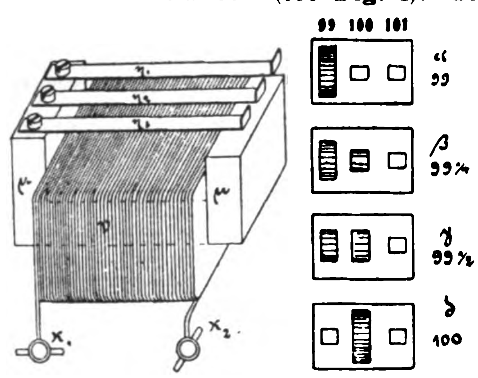


FIG. 5.—HARTMANN-KAMPF FREQUENCY INDICATOR.

needles d_1, d_2, slide along the four combs, k_1, k_2, k_3, k_4, which are constructed of thin mica and metal plates, ¼ mm. in thickness, superposed and compressed; the resistances w_1, and w_2, w_3, w_4, being

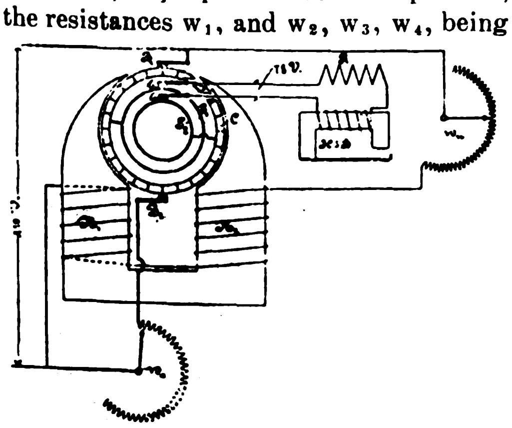


FIG. 6.—DETAILS OF SPEED REGULATOR CONNECTIONS.

inserted between the various pairs of metal plates. In the figure only five metal plates are shown for each comb, whereas in the actual arrangment used by Prof. Korn, 26 plates are being used, the total length of the comb being about 16 mm. Prof. Korn thinks, however, 10 metal plates to be quite sufficient. The wires s_1, s_2, connect with the poles of the Tesla coil, and the wires r_1, r_2, with the tube. The combs are mounted on indiarubber insulating supports, while the resistances w are placed in special boxes.

one whose period is in resonance with the period of the alternating current will be caused to vibrate by an electromagnet excited with the current. In Fig. 5, η_1, η_2, η_3, represent three such springs having the period of 99, 100 and 101 respectively, K_1 and K_2 being the terminals connecting to the alternating current that traverses the coil v round the iron core μ consisting of transformer plates. In α,

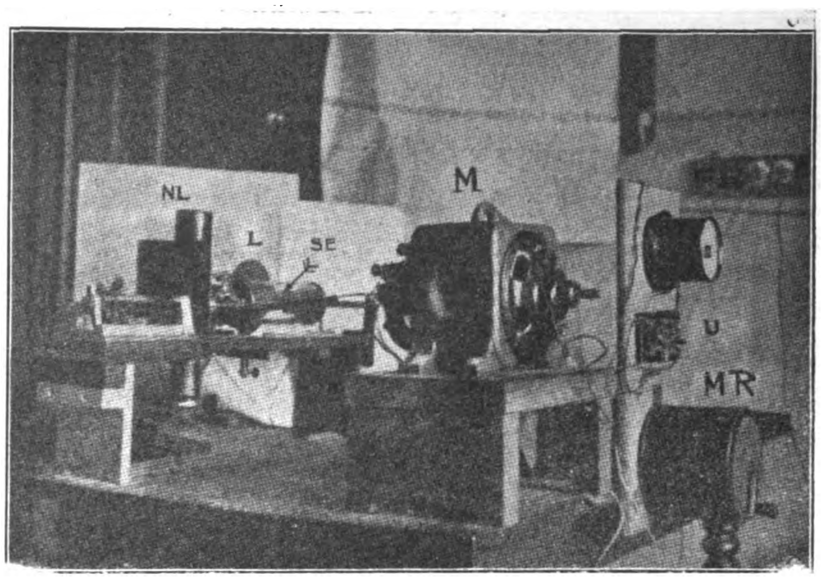


FIG. 2A.—VIEW OF THE SENDING APPARATUS.

FB—Frequency Indicator. L—Lens. M—Electromotor. MR—Motor Regulator. NL—Nernst Lamp. SE—Selenium Cell. U—Switch.

The transmission of a photograph of 9 × 16 cm. requires just 30 min. with the speed of roller at present used, the limiting factors being the inertia of the selenium in the transmitter and the inertia of the galvanometer in the receiver.

In order to compensate for possible errors due to the inertia of the selenium, the space left free on the sender roller is used for inserting a uniformly illuminated film-strip serving to check the working of the selenium. If any error be noted, the sensitiveness of the galvanometer has to be altered accordingly.

Special care has been bestowed by Prof. Korn on the design of the apparatus for securing the synchronous rotation of the rollers. As it is quite impossible to obtain absolute synchronism, the unavoidable small errors occurring have to be compensated for at reasonable intervals, so as to prevent them from becoming appreciable. Continuous current ½ hp. shunt-wound motors are used for obtaining a uniform rotation of the cylinders, current being supplied from accumulators. For measuring and adjusting the proper speed, one of the motors is fitted with collector rings for alternating-current supply, the latter being led on to a Hartmann-Kampf frequency indicator. This (Fig. 5) is based on the principle that, out of a series of tuned springs, the

β, γ, δ, a front view of the spring in the actuated state is shown for the period 99, 99¼, 99½ and 100 respectively. In Fig. 6 the connections for the speed regulator are shown diagrammatically. B_1 B_2 are the continuous current brushes, C the commutator, S_1 S_2 the collecting rings, b_1 b_2 the brushes intended for collecting alternating current, R a shunt resistance for the frequency indicator H and B, w_a the starting resistance of the motor, and w_n the regulating resistance of the shunt.

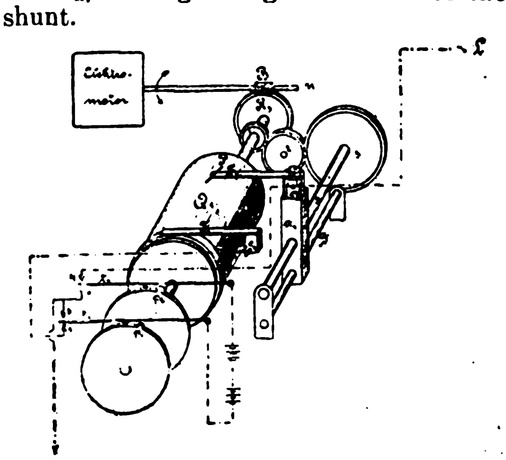


FIG. 7.—SENDING DEVICE FOR TRANSMITTING HANDWRITING.

In order to simplify the necessary corrections for the errors in synchronism, the speeds of the motors at the two stations are arranged to differ from one another. At the sending station the fre-

quency adopted is 99½, that at the receiving station being 100½. Any regulation is therefore only necessary in one direction, and after each revolution the more rapidly rotating roller has to be stopped by $(\frac{1}{100} + \varepsilon)$ of the time of rotation, where ε is the positive or negative relative error of synchronism.

When handwriting or drawings are to be transmitted, a sending device constructed on Bakewell's principle may be used, in which the writing or drawing is made with non-conducting ink on a metal foil. The metal foil (Fig. 7) is wound round the indiarubber cylinder Q_1 of the same dimensions as the receiving cylinder. The support a_1, along with the spring F_2 and the metal pin P, are made to slide over the metallic surface from which the current is led through a sliding contact into the line wire, the circuit being broken whenever the pin P touches a non-conducting portion of the metal foil.

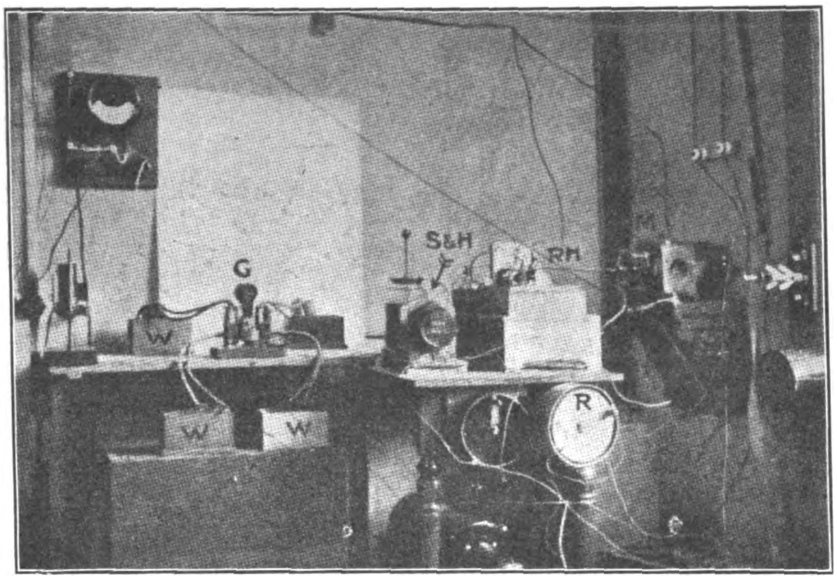


FIG. 3A.—VIEW OF THE RECEIVING APPARATUS.
G—Galvanometer. R—Regulating Resistance. S & H—Relay.
WW—Resistances. M—Electromotor. RH—Geissler Tube.

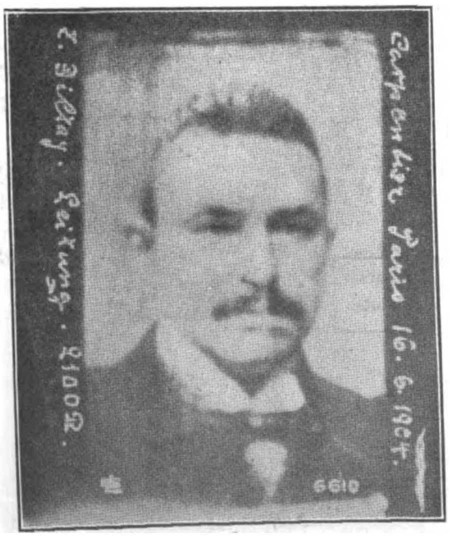


FIG. 8.—A TRANSMITTED PHOTOGRAPH.

In the receiving apparatus the galvanometer is replaced by a polarized relay which actuates a high-tension relay connected to the Tesla coil circuit. When the circuit is broken by the sending apparatus, variations in the Tesla coil current are produced, which are utilized for forming, on the receiving film, dots which compose the writing or line.

By means of the latest apparatus, 500 words in ordinary handwriting, or from 2,000—2,500 words in shorthand, may be transmitted per hour.

In Fig. 2A we reproduce a photograph of the transmitting, and in Fig. 3A one of the receiving stations.

Prof. Korn has successfully transmitted photographs over the Munich-Nurnberg line, one of which is reproduced in Fig. 8.

Transactions of the International Electrical Congress.

The transactions of the International Electrical Congress are now being prepared for the press and will contain 153 specially invited papers, together with the discussions thereon at St. Louis, and a report of the proceedings of the Chamber of Delegates. They will form three large octavo volumes, each of which will contain about 900 pages, and a frontispiece engraving, two frontispieces being group photographic views and the third a view of the Electricity Building at the Exposition. The membership roll of the Congress closed on the last day of the meeting, September 17, but anyone desiring to obtain a copy of the transactions can do so by subscription. Subscriptions will be received until December 1. The subscription price is $10, which includes the cost of delivery to the subscriber. As it is not intended to print a reserve stock. and only those for the Congress membership, or on order, are being at present printed, orders should be sent in promptly to the treasurer, Mr. W. D. Weaver, 114 Liberty street, New York City. The volumes will constitute a valuable landmark in the literature of electrical science and engineering.

The Electric Locomotive a Great Success.

The official trial of the locomotive built by the General Electric Company for the New York Central Railroad took place in Schenectady on Saturday. A train of four cars was carried about 70 miles an hour. On another test the regular fast mail on the New York Central was outdistanced for six miles. All tests were a complete success. The engines will not be in use on the Grand Central terminals until 1906, as the excavation for the tracks cannot be done before. Thirty of the locomotives have already been ordered and the number will be increased to fifty.

Elaborate Light System in Pittsburg.

Robert C. Hall, active in the promotion of the new Duquesne Light Company of Pittsburg, Pa., is in New York on business connected with the scheme. He states that the company will expend $2,500,000 in erecting one of the most modern and complete electric lighting plants in the country, and that the well-known interests in control of the Pittsburg & Allegheny Telephone Company were in control of the Light company.

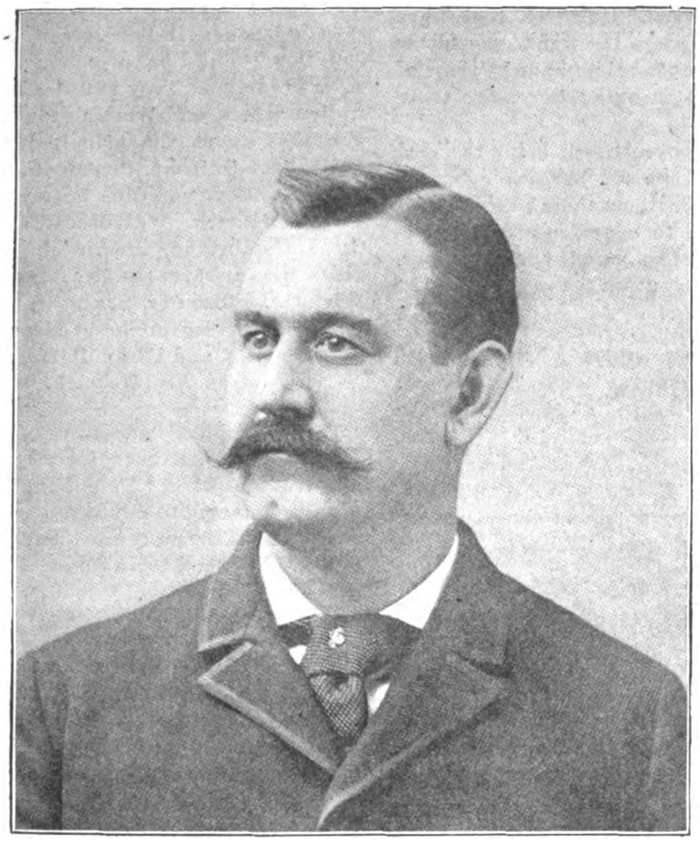
Lectures on Electrical Engineering.

Mr. George Howe, M. E., has planned a course of lectures to meet the requirements of practical engineers and engineering students who have not had the advantages of a college education. His idea is to equip such men with a fundamental knowledge of mathematics and the theories of electrical engineering. The course will extend over a period of six months, and consist of two lectures per week. The lecture hall of the Price-Cottle Conservatory of Music, 2105 Seventh avenue, New York City, has been engaged for these lectures. Mr. Howe was formerly instructor of physics at Tulane University, and lecturer in electrical engineering in the Young Men's Christian Association night lecture courses, New Orleans. His present address is 129 West 117th street, New York City.

JUDGE JAMES M. THOMAS DEAD.

Ex-Judge James M. Thomas died November 8 at his home in Irvington, N. Y., aged 46 years.

He was born in Clarksburg, O., and was a lineal descendant of Samuel Thomas, who came to America in the Mayflower. He was a student in Wesleyan University, taught school, studied law in Chillicothe, O., and was admitted to the bar in June, 1884. He served two terms as Probate Judge in Ross County, Ohio, and shortly afterward was elected president of the Independent Telephone Association of America. There is no doubt that his earnest work for several years was a potent factor in the general success of the Independent telephone cause in the United States. He drew together the discordant parts of the Independent system, secured united action on vital questions, particularly those of patent litigation, and saw his work crowned with success. Later he was made president of the United States Company, with headquarters at Cleveland. This he resigned to come to New York and accept the position of president of the American Cable & Telephone Company. Within the past two years he had reorganized the Aetna Indemnity Company. He was a member of the Union League Club and the Ohio Society. He leaves a widow and four children.



James Milton Thomas.

"Graphite Lubricants."

A new catalogue has just been issued describing the many famous graphite lubricants manufactured by the Joseph Dixon Crucible Company, Jersey City, N. J.

The introduction deals in a general way with the growth of the graphite industry, the theory of graphite lubrication, the advantages of flake graphite in contrast to amorphous graphite and the practical relation of graphite to the theory of lubrication. "It is a fact worthy of greatest emphasis that bearings absolutely cannot 'seize' or cut whenever an infinitely thin film of flake graphite coats the friction surfaces. If Dixon's Flake Graphite could do nothing else for the operator of machinery its importance in averting troubles and shut-downs and perhaps disasters, due to the seizure of bearings, cannot be over-estimated."

The book further describes the various lubricating graphites and graphite lubricants of the Dixon Company, including their general uses and the retail prices of the different sized packages. Among them are mentioned Dixon's Ticonderoga Flake Graphite, Special Graphite No. 635, Heavy Graphite Machine Grease, Waterproof Graphite Grease, Graphite Cup Greases, Axle Grease, Automobile and Cycle Lubricants, Handy Graphite Rope Dressing, and Graphite Pipe Joint Compound.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOV. 8, 1904.

Electric Railways and Appliances.

774,396. Retractable Car-Fender. Andrew D. Pidgeon, Chicago, Ill. Filed Aug. 10, 1904.

774,481. Railway Signal System. Oscar J. Lee and Myron H. Richardson, Chicago, Ill. Filed June 2, 1902.

774,498. Automatic Interlocking Signal System for Railways. Benton C. Rowell, Chicago, Ill., assignor to the Rowell Potter Safety Stop Company, Portland, Me. Filed May 19, 1900.

774,524. Trolley-Guard for Electric Railways. John Kress, New Rochelle, N. Y. Filed March 16, 1904.

774,534. Trolley. John W. Rockafellow, Sergeantsville, N. J. Filed Aug. 18, 1904.

774,620. Railway Signaling Apparatus. Charles W. S Turner, Mountville, Va. Filed Dec. 22, 1903.

774,717. Railway Traffic-Controlling Apparatus. Clyde J. Coleman, Rockaway, N. J., assignor to the Hall Signal Company. Filed April 11, 1904.

Electric Lights and Appliances.

774,403-404. Machine for Making Bases fer Incandescent Electric Lamps and Base for Incandescent Lamps. Alfred Swan, New York City, assignor to the General Electric Company. Filed March 25 and April 1, 1901.

774,669. Hanger for Electric-Arc Lamps. Walter J. Jones, Newark, N. J., assignor to Albert S. Martin, East Orange, N. J. Filed May 24, 1904.

Electrical Machinery and Apparatus

774,158. Protective Device for Electrical Circuits. Frank B. Cook, Chicago, Ill. Filed Nov. 13, 1903.

774,160. Self-Soldering Terminal Protector. Frank B. Cook, Chicago, Ill. Filed March 26, 1904.

774,163. Brush-Holder for Electric Generators. Isidor Deutsch, Montreal, Canada, assignor to the Electric & Train Lighting Syndicate, Limited, same place. Filed May 14, 1903. Renewed March 25, 1904.

774,181. Electric Interrupter for High-Frequency Currents. George E. Johnson, Fort Wayne Ind. Filed Dec. 7, 1903.

774,202. Electrical Connection. Frank J. Russell, New York City. Filed Jan. 7, 1904.

774,728. Liquid-Contact Chamber for Electrically-Wound Mechanism. Percy L. Clark, Bristol, Conn., assignor, by mesne assignments, to A. L. Clark, Elgin, Ill. Original application filed Oct. 13, 1902. Divided and this application filed Dec. 2, 1903.

Telephones and Telephone Apparatus.

774,265. Toll-Collecting Appliance for Telephone Pay-Stations. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Filed Feb. 10, 1900.

774,283. Apparatus for Telephone Trunk-Lines. Edward B. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Filed April 27, 1903.

774,332. Signaling Apparatus for Telephone-Switch-boards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Filed Dec. 26, 1899.

774,543. Party-Line Telephone Systems. Felton Vollmer, Winsted, Minn. Filed Nov. 20, 1903.

774,608. Attachment for Party-Line Telephone Systems. William A. Shackelford, Lexington, Ga. Filed Dec. 3, 1903.

Miscellaneous.

774,230. Electrolytic Apparatus. Arthur Brichaux, Brussels, Belgium, assignor to the Solvay Process Company, Syracuse, N. Y. Filed Oct. 4, 1898.

774,320. Electric Signal. Frederick H. Gray, Leavenworth, Kan., assignor of one-half to Walter V. Thomas, same place. Filed Feb. 1, 1904.

774,342. Burglar-Alarm System. Harold D. Stroud, Chicago, Ill., assignor of one-half to A. Miller Belfield, same place. Filed Dec. 22, 1902.

774,460. Rheostat. Montgomery Waddell, New York City. Filed Nov. 25, 1903.

774,494. Speed Control of Electrically-Propelled Vehicles. John S. Raworth, London, Eng. Filed June 5, 1903.

774,529. Electrothermic and Vacuum Appliance. Charles C. F. Nieschang Fort Wayne, Ind. Filed Aug. 29, 1904.

774,611. Electrical Coupling. Frank J. Sprague, New York City, assignor to the Sprague Electric Company, Bloomfield, N. J. Original application filed April 30, 1898. Divided and this application filed July 7, 1900.

774,618. Electrically-Operated Block-Signaling Apparatus. Charles W. S. Turner, Mountville, Va. Filed Dec. 22, 1903.

THE TELEPHONE WORLD.

People's Telephone Company Installing Many Cables.

The People's Telephone Company is installing a great deal of cable service in various parts of Knoxville, Tenn. These cables are capable of accommodating from 100 to 400 wires. Six car loads were purchased this season.

The cables have been put in the underground conduits, which were put down during the summer. The wires have not yet been connected to the cables, however, but this will be done soon.

With all of the new cable service there will be no danger of breaking wires, and the service will be much improved.

Independent Union Company Changes Office.

The Independent Union Telephone Company, which has had its principal office in Buffalo, N. Y., has filed with the Secretary of State a certificate changing its office to Albany. The company is represented by Attorney Howard Hendrickson, of Albany, and among its directors are Irving H. Griswold, Samuel B. Rawson, Frederick H. Sudro and Theodore M. Brush, of Elyria, O., all of whom are directors of the Albany Home Telephone Company.

The H. & W. Telephone Company, of Wrightstown, Minn., filed articles with the Secretary of State a short time ago The company is to connect the towns, cities and villages in Otter Tail County and other counties of the State by telephone, head offices to be maintained in Wrightstown. The paid in capital is $4,995; but this will be increased to $50,000 as the incorporators see fit. They will be liable at no time for more than $1,000. The incorporators are H. S. Aldrich, George E. Perkins, M. M. Sparks, E. W. Smith, A. A. Burch, L. E. Campbell and J. W. Merickel.

The village board of Mackinaw, Ill., at its regular monthly meeting, took up the application for a franchise presented by the Farmers' Telephone System of Hopedale, and after making a few changes in the application granted said company a 20-year franchise. One of the most important changes made in the application was to the effect that the board retained the power to control the setting of the poles and the situation for the headquarters.

The Manokin Telephone Company is building a line between Princess Anne and Deal Island, Md.

The Southwestern Telegraph & Telephone Company will put in a new system at Newport, Ark., at a cost of about $20,000.

The Wabash Telephone Company has installed a new switchboard in Monroe City, Ind., to accommodate its patrons.

The new long-distance telephone company is preparing to build a line between Columbus and Hope, Ind.

The establishment of an automatic telephone exchange in Tiverton, R. I., is now being considered.

Telephone Trouble in Dalton, Ga.

Dalton is in the midst of a telephone war of no small proportions. Some time since the local exchange promulgated an order refusing the use of telephones to non-subscribers, with some restriction, however. Considerable bitterness arose as a result. Some days since the telephone company issued a new schedule of prices increasing the rate for business telephones.

Coming as it did on the heels of the former disagreement, a large number of the business men of that city held a meeting and ordered their 'phones removed. As a result some 60 or more telephones were removed November 1, and the work is still in progress. The local exchange has been very successful and had a large list of subscribers. However, both sides seem determined to wage the war to the bitter end. Vigorous effort is being made by some of the business men to get others to remove their instruments.

It is alleged that boycotting is being resorted to by merchants to force all business concerns and offices to discontinue their 'phones. An effort is being made to organize another telephone system for Dalton, and it is claimed parties are now ready to put up the cash to put the new system in operation.

The incorporation papers of the Lester, N. Y., Telephone Company were lately filed. The company is capitalized at $2,000, and the directors are W. Wightman, H. S. Williams. A. S. Judd, C. H. Smith, A. H. Andrus, A. H. Moore and Morton J. Brown, all of Windsor, N. Y. The company intends to build a telephone line from Lester to Windsor, to the State line and to Binghamton.

The L. M. Ericsson Telephone Manufacturing Company of Tonawanda, N. Y., capitalized at $200,000, has been incorporated with the following directors: Axel Bostrom, Stockholm, Sweden, and F. M. Parke and C. H. Smith, of Buffalo.

By July next, the Maryland Telephone & Telegraph Company expects to have its lighting plant in operation in Baltimore. Contracts for building the plant and installing the machinery have been let, and work on the building has been started.

A report from Elkton, Md., states that the capital stock of the Cecil Farmers' Telephone Company will be $25,000. This company will build an Independent line.

W. B. T. Belt, who has been manager for the Omaha branch of the Nebraska Telephone Company, has been appointed to the position of general superintendent of the entire system.

The telephone line from Stittville to Floyd Hill, N. Y., is nearly completed.

A new line of telephone is completed to Tallula, and also a new circuit to Greenville, Miss.

The Conestoga, Pa., Telephone Company is extending its lines from Plowville to Conestoga.

Thieves recently stole 60 yards of wire from the Delaware & Atlantic Telephone line at Carrcroft, Del.

Cumberland Telephone Case.

One of the cases on the Davidson County docket of the Court of Chancery Appeals for November 22, in which general interest will be taken, is that of the State of Tennessee ex. rel. vs. the Cumberland Telephone Company. By a lower court the Cumberland Telephone Company was declared to have forfeited its right to do business in Tennessee. The case was appealed from the decision of the Chancellor to the Supreme Court, and being on the equity docket goes through the Chancery Court of Appeals.

Articles of incorporation of the Johnsonville, N. Y., Telephone Company have been filed with the county clerk. The new company is to do business in Rensselaer and Washington Counties. The line of communication to be covered includes Troy and the following places in Rensselaer and Washington Counties, with Johnsonville as the principal office: Valley Falls, Schaghticoke, Pittstown, Melrose, Raymertown, Boyntonville, Potter Hill, Buskirk Bridge, Hoosick, West Hoosick, Easton, White Creek, Cambridge, Greenwich. The incorporators, who are also the directors, are Jay D. Van Wirt, G. Ira Hayner, Ernest H. Abbott, Clarence M. Herrington and Clarence E. Akin, of Johnsonville, and Hiram P. Sherman and E. D. Herrington, of West Hoosick.

The telephone company of Germantown, N. Y., which has been formerly controlled by the Hudson River Telephone Company has been transferred to a business man of Germantown. It has been formed under a new head called the Germantown-Blue Store & Clermont Telephone Company.

The Winona, O., Telephone Company has completed a line to Millport connecting with the Dungannon central. From Millport a line is being run to Gavers and the company is contemplating running one to Lisbon.

Pierce County, Wis., Telephone Company, by F. M. White, president, and W. H. Currier, secretary, recently filed an amendment increasing the capital stock from $10,000 to $30,000.

The Emmet County Telephone Company seeks a franchise for a new exchange in Estherville, Ia.

Telephone Incorporations.

The New Albany Telephone Company, New Albany, Pa. Capital stock. $5,000.

The Citizens' Telephone Company, Akron, N. Y. Capital stock, $10,000 Directors: J. W. Stearns, R. H. Bell and F. D. Eckerson, all of Akron.

The New Lebanon Telephone Company, New Lebanon, Pa, Capital stock, $10,000. Incorporators: D. C. Mills, V. E. Weaver, G. C. Smith, George W. Hopner and S. P. Dill.

The West Texas Telephone Company, Brownwood, Tex.—to construct, operate and lease telephone and telegraph lines and telephone exchanges. Capital stock, $1,000. Incorporators: G. N. Harrison, N. H. Hollingsworth, H. T. Williams, J. A. Walker, G. H. Woodward, of Brownwood; L. R. Conroe, of Goldthwaite, and R. G. Hollingsworth, of Coleman.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Anna, Ill.—The Anna electric light plant was lately destroyed by fire.

Camilla, Ga.—The citizens have voted in favor of issuing $20,000 bonds for a water and electric light plant.

Chadron, Neb.—William McCarthy has charge of the construction of the new electric light plant here.

Coalgate, I. T.—The city council has granted a franchise to the Coalgate Company to construct and operate an electric light system.

Columbus, O.—The city electric light plant will be in operation in some parts of the city by January 15.

Dalhart, Tex.—The Dalhart Ice & Electric Company has been incorporated with a capital of $1,000 by W. H. Wolff, C. G. Foulks and others. It will operate an electric light plant.

Fairfield, Ia.—This town is to be thoroughly lighted by electricity.

Georgetown, Ill.—The city council is considering the proposition of a Chicago man to establish an eletric lighting plant.

Jonesboro, Ala.—It is understood that a move is on foot by which the Birmingham Railway, Light & Power Company will run its lines to this place, furnishing electric lights for the town.

Jonesboro, Ill.—The electric light plant here was totally destroyed by fire, but work on the new plant will soon begin.

Kearney, N. J.—The lighting committee of the common council at a recent meeting of that body reported favorably upon the proposition to establish a municipal electric lighting plant, and was empowered by the unanimous vote of the council to engage an expert engineer to further investigate the matter and decide upon the approximate cost of the erection and maintenance of such a plant.

Laredo, Tex.—Mason Williams, of San Antonio, is looking over the electric light plant here, and also the street railway properties, with a view to improving the same.

Mahaffey, Pa.—The men associated in the iron works plant are organizing an electric company and will soon be ready to supply this town with light.

Meridian, Miss.—J. T. Gibson, manager of the electric plant and railway company, has announced that $100,000 will be spent in improving both services.

Monticello, Fla.—The council has contracted with J. M. Henry, Jr., and C. L. Thompson for an electric plant for this city.

New Castle, Del.—The Delaware Water & Improvement Company, of which James M. Seabury, of Philadelphia, is the president, was granted a franchise to operate an electric light and water plant here.

Northfield, Vt.—The electric light plant in this city, was recently destroyed by fire. The loss is estimated at $20,000.

Omaha, Neb.—The people of this city will vote on an issue of $500,000 of bonds for the construction of a municipal electric street lighting plant

Peru, N. Y.—The residences and business houses of this village are to be lighted by electricity. The current is to be furnished by the Keeseville Electric Company over a 6-mile line.

Plaquemine, La.—A franchise to erect an electric light plant in this city has been granted to Victor M. Garber.

Potomac, Ill.—R. C. Wilson is preparing to install an electric light plant here, and will begin work at once.

St. Joseph, Mo.—Ben Trunk, architect, is preparing plans for the new city electric lighting plant.

Tennille, Ga.—The recent bond election, which was to ratify the action of the council issuing bonds for the purpose of improving the water system and buying an electric light plant, resulted in an almost unanimous vote for the issuance.

STREET RAILWAYS.

Anna, Ill.—The Union County Traction Company has been granted a franchise to connect this place and Jonesboro.

Bangor, Me.—Considerable activity in electric railroad building is looked for in this State next year. Among the lines to be built will be one by the Eastern Traction Company between this city and Dexter, a distance of about 33 miles.

Denver, Col.—An electric line is to be built from Greeley to this city by the Carmichael Investment Company to run through Arapahoe County.

Dixon, Ill.—The Freeport-Dixon Electric Railroad Company has applied for the right to build a line here,

Grand Haven, Mich.—The board of supervisors has granted a franchise to the Riverside Electric Railway Company to run through the county.

Hattiesburg, Miss.—This place is to have an electric line. F. W. Foote is one of the promoters.

Iowa City, Ia.—The Iowa City & Davenport Interurban Railroad Company has been incorporated here to construct an electric line between this city and Davenport. The capital stock is $100,000. Hon. Milton Remley, C. S. Ranck, Stephen Bradley and others, are at the head of this company,

Minneapolis, Minn.—The Mille Lacs & Minneapolis Electric Railway Company, with $150,000 capital stock, has been incorporated to run a line from the south shore of Mille Lacs southward 88 miles through Mille Lacs, Sherburne, Wright or Anoka and Hennepin Counties to this city. The line may also be built from the north shore northward to Aitkin. The officers are: President, C. S. Kathan, of Mora, vice-president, F. P. McQuillan, of Aitkin; secretary and treasurer, J. N. True, of Little Falls.

Mineola, N. Y.—The Nassau County supervisors will hold a public hearing here on December 12 to consider an application received from the Central Long Island Electric Light & Railroad Company asking consent to construct, maintain and operate a street railroad for public use in the county, beginning at the county line of the Milldam road, at Coldspring Harbor, and extending to East Norwich, Oyster Bay, then to Glen Cove, Bayville, Locust Valley, Sea Cliff, Roslyn, East Williston and to Mineola.

Morristown, Tenn.—Eastern capitalists are organizing a company here for the purpose of building an electric car line on the principal streets of this city. John Lykes, a local attorney of this city, is the representative of the company.

Oakmont, Pa.—An electric railway is to be built to be known as the Pittsburg & Allegheny Valley Railway Company to run from this place near Pittsburg to Apollo, and then as far as Johnstown. O. W. Kennedy, of Uniontown, is the president of the company; J. D. Orr, of Leechburg, is secretary.

Rome, N. Y.—The Citizens' League & Employment Association met recently and discussed the proposed trolley from here to Boonville. Reports from Western were to the effect that the people there favored the idea, and would give $30,000 towards the stock, and give at least 15 tons per day in freight business.

Rush, N. Y.—This town has granted a franchise for the operation of an electric railway through this place, as part of the line planned between Rochester and Elmira.

Sedalia, Mo.—The Sedalia Transit Company has been organized for the purpose of building and operating an electric railway in this city. H. S. Rumsey, of St. Louis, is president.

Springfield, Ill,—Surveys have begun for an Interurban electric railway from this city via Petersburg to Beardstown.

St. Bernard, La.—The citizens are beginning to feel assured that an electric line will be constructed. It is said that two companies are eager to build the street railway. President Elwyn C. Foster, of the New Orleans Railways Company, is interested.

Syracuse, N. Y.—The Auburn & Syracuse Electric Railroad Company has decided to expend $100,000 in double tracking five miles of its road west of the city limits, and to purchase new cars and other equipment.

Vineland, N. J.—There is considerable talk of the construction of a trolley road between this city and Bridgeton.

POWER PLANTS.

Baltimore, Md.—It was lately announced by S. D. Warfield, chairman of the executive committee of the United Electric Light & Power Company, that plans have been consummated for the erection of the largest electric light and power generating station in the United States. The company has purchased 22 acres of land immediately adjoining this city, and having a water front of over 1,000 feet. The new generating station will provide for all needs of the city for electric light and power for many years to come.

Danielson, Conn.—A plant similar to the one at the Dyer dam in Killingly is to be built to supply power for the Providence & Danielson Electric Road.

Pittsburg, Pa.—The Duquesne Light Company has been granted a franchise and will erect a power plant soon. J. G. Splane is a director of this company.

BIDS WANTED.

Dallas, Tex.—This city will construct an electric light plant with a capacity of from 500 to 1,000 street arc lights. Plans, specifications and sealed proposals will be received until December 1. Address M. T. Winslett, city secretary.

Newport, Ky.—Sealed proposals will be received until December 1. by P. J. Krebs, city clerk, for lighting the city.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 14⅜@14½c.; Lake 14⅜@14⅝c.; casting, 14@14¼c.

The rise in Chicago Union Traction was understood to indicate that Judge Grosscup's decision will be favorable to the company.

The stockholders of the Metropolitan Street Railway Company will hold their annual meeting in this city on November 25. Books close November 23 and reopen December 6.

The report is current in Chicago that about $5,000,000 receivers' certificates may be issued by the Union Traction Company, the proceeds of which are to be used in rehabilitating the road.

A dispatch intimates that the assessment on the stock of the Philadelphia Rapid Transit Company will be $10 a share, and that an issue of $10,000,000 bonds is to be authorized, but not to be issued for a year or more.

J. Pierpont Morgan is the heaviest individual stockholder in the Edison Electric Illuminating Company of Boston. Mr. Morgan holds 3,099 shares of stock out of 104,491 shares outstanding. As Edison stock is to-day selling around $250 a share, Mr. Morgan's holdings represent $774,750.

The New York Stock Exchange has granted the application of the Underground Electric Railways Company of London, Limited, for the listing of its 5 per cent. profit-sharing secured notes. This is the first time that the securities of a European street railway have been listed on the New York Stock Exchange.

A reorganization committee has been formed of the New Hampshire Traction Company, consisting of Otto T. Bannard of New York, chairman, Alfred D. Foster and Charles F. Ayer of Boston. About $4,000,000 of the $6,000,000 four and a half per cent. bonds outstanding have already been deposited with the New York Security & Trust Company. The time to deposit expires November 19.

The announcement that the Westinghouse Electric & Manufacturing Company has not had a meeting of its stockholders for seven years, although its board of directors has just decided to issue $15,000,000 of 5 per cent. debentures, was made in Pittsburg recently and caused surprise. It was announced further that the stockholders did not pass on the issue of the bonds and it is intimated that some of them are disgruntled.

The Commercial Cable Company is sending to its stockholders notice of a special meeting to be held in New York on November 22, to act upon the proposition to alter the company's certificate of incorporation. It is proposed to give the company power to purchase and dispose of the stock and bonds of any foreign or domestic corporation. It is also proposed to give the company power to lease or sell its property and franchises to any telephone corporation provided such lease, sale or purchase shall have been ratified by a three-fifths vote of the directors and stockholders.

The consolidated mortgage guaranteed 4 per cent. gold bonds of the Nassau Electric Railroad Company of Brooklyn, N. Y., are offered for sale by Charles Minzesheimer & Co. of this city. These bonds are a direct obligation of the company besides being guaranteed by the Brooklyn Heights Railroad Company. The Nassau system directly, and by ownership of other properties, largely controls the Coney Island traffic and, in addition, it owns the Atlantic Avenue system which carries the passenger traffic coming and going from the ferries and bridges connecting New York and Brooklyn.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Nov. 14
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	164¾
Metropolitan Street Railway	123⅜
Metropolitan Securities	82¾
Ninth Avenue	197
Third Avenue	131
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	69¼
Public Service Corporation (New Jersey)	104
Philadelphia.	
Consolidated Traction of New Jersey	78
Philadelphia Traction	98
Union Traction	56¾
Boston.	
Boston Elevated	154⅛
Massachusetts Electric Companies, com	15½
do. do. do. pref.	57
West End Street, com	91½
do. do. do. pref.	112
Chicago.	
City Railway	185
North Chicago	71
Union Traction, com	14
do. do. pref.	40
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16½
do. pref.	61
Electric Boat, com	40
do. do. pref.	71
Electric Lead Reduction	½
Electric Vehicle, com	16
do. do. pref.	22
Westinghouse, com	174
do. pref.	190
General Electric	182
Boston.	
Edison Electric Illuminating	250
General Electric	182
Westinghouse Electric & Mfg., com	86
do. do. do. pref.	95
Chicago.	
Chicago Edison	160
National Carbon, com	37
do. do. pref.	110
Philadelphia.	
Electric Company of America	10¼
Electric Storage Battery, com	75
do. do. do. pref.	75
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	143½
Western Telephone Company	19
New England Telephone Company	134½
New York.	
American Telegraph & Cable Company	93½
Commercial Cable Company	210
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92¼
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	48
Consolidated Car Heating	64
Standard Underground Cable	200

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CONTENTS.

EDITORIAL NOTES.

Third-Rail Dangers.

The controversy respecting the danger of third-rail electric traction systems continues to wage with unabated vigor in the columns of the English press, both newspaper and technical, writes our London correspondent.

The same may be said of the press in this country, as scarcely a day goes by but what one or more articles appear in the daily papers condemning the third-rail as it now exists on the elevated roads of Greater New York.

The third-rail from which current is taken to operate the cars in the new underground road is covered by a hood. This protects the track inspectors and laborers. On the elevated roads no similar precautions have been taken to protect the employes, nor the lives of passengers who are occasionally obliged, through a break-down, to get out and walk to the nearest station. The lives of firemen are also frequently placed in jeopardy by this exposed rail. Our correspondent in London states that Prof. Silvanus P. Thompson objects to the third-rail and even goes so far as to advocate the adoption of single-phase alternating current railways with overhead wires, especially in the open country.

In spite of all that is being said in England and this country against the "deadly third-rail" there would seem to be no good reason why it should actually be condemned, provided proper precautions are taken in connection with its use. As we have frequently stated in these columns, it would be a comparatively simple matter, and one not involving an enormous expense, for the elevated roads in this city to protect the live rail with a hood, in much the same way that the underground rail is now guarded. Whether such an arrangement could be made to work satisfactorily in the open country in winter on a road like the New York Central remains to be seen, but it could certainly be made to operate on the elevated roads of this city and would be the means of saving lives, which through carelessness or accident would otherwise be lost.

* * *

Central Station Economy.

In the days when electricians were glad to see a dynamo spark—because it showed that electricity was being developed, and that, three decades ago, was quite an achievement—in those days the building of central stations was a dream of the far distant future.

But since that time the arts and sciences have made great progress—the art of construction and the science of design—and now the dynamo that sparks is regarded as an evidence of bad engineering, its builder is criticized and his product shunned.

The faulty dynamo is a money waster, and a central station equipped with generators whose sparking is pronounced and regulation bad, would be considered today as a monstrous exhibition of financial recklessness bordering on prodigality. Recklessness, because of the great care and expense such an installation would engender, and prodigality, because of the large sums of money that would have to be subsequently spent to keep it in safe running order.

In other words, the drift is distinctly towards a business basis, it being understood as a foregone conclusion that generators, switchboards and wiring shall be of the best. This, it seems, is the beginning of station economy though not by any means all of it.

The efficiency of the lamps operated on

the line, the efficiency of the engine, generators and wiring system, and finally the relationship of the total investment to the annual profits are matters that call for careful consideration and investigation by both the electrical engineer and financier.

If engineering, as once defined by one of its illustrious exponents, is the art of making money, then, in such cases as central station management, where the mechanical and electrical departments of it must join hands as it were, the art must be demonstrated without fail to a large and interested circle of stockholders.

To accomplish this is a task, which fully tests the business management and the general public. The public, we must remember, must be well served—their bills reasonable and the power reliable—otherwise the goose is killed that lays the golden eggs. As far as the station is concerned the margin is very small. By this is meant that a good engine has 14 per cent. efficiency, the dynamo about 90 per cent. and the line about 90 per cent.: this gives a total of 11.34 per cent. from the coal to the lamp. If the lamps are 3 watt, the profits are naturally less than for 2.5 watt lamps. The question is a delicate one and has bothered many station managers. It is so dependent upon the regulation and this in its turn upon the character of the machinery and the load. For this reason, with only 11 per cent. to economize with, central station management with its ultimate object, central station economy, must certainly develop into a fine art to become a practical and financial success.

* * *

Telegraph Pole Tests.

More than usual interest attaches to the announcement of the Bureau of Forestry of the Department of Agriculture that it has just signed an agreement to make extensive timber seasoning tests in two Western States, in co-operation with two telegraph and telephone companies. The experimental stations will be located at Marinette, Wis., and Escanaba, Mich., and it is probable that a third station will also be established at Ashland, Wis. The expense of the experiments will be borne jointly by the Bureau and the companies, while cedar and tamarack telephone and telegraph poles will be furnished by the State of Wisconsin free of cost.

The object of the experiments is to determine how many years can be added to the life of each pole by proper seasoning. Since millions and millions of poles are used along telegraph and telephone lines, even one year's extra service for each pole will amount to a tremendous saving in expense. Unseasoned cedar poles last from twelve to fifteen years. Seasoning experiments have shown how to increase this time by three or four years, and it is now expected to improve on this increase. Past methods of seasoning have effected a drying out of 20 per cent. of the original weight of the poles. The better seasoned the pole the less chance there is for decay which is promoted by moisture.

Such experiments are of large importance not only to telegraph and telephone companies, but to all users of heavy timbers which come in contact with the ground, at which line decay gets in its most deadly work. It is believed that still greater economies can be secured by the use of proper methods of preservative treatment.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The electrical company to be established under the auspices of the Deutsche Bank, T. A. Edison and the Bergmann Electrical Works of Berlin, will be located in Germany and not in the United States. The company is organized for the utilization of Mr. Edison's storage battery.

Mr. W. S. Barstow, Mr. Charles F. Scott, Dr. Louis Duncan and Dr. F. A. C. Perrine now constitute the staff of consulting professors of the Polytechnic Institute of Brooklyn, N. Y.

The next annual convention of the Interstate Independent Telephone Association of America will be held at the Auditorium Hotel, Chicago, December 13, 14 and 15.

The 191st meeting of the American Institute of Electrical Engineers will be held at 8:15 P.M., Friday, November 25, in the Chapter Room, Carnegie Hall, 154 West 57th street, New York. The following paper will be presented and discussed: "Problems of Electric Traction on the Long Island Railroad," by O. S. Lyford, Jr., electrical engineer, Westinghouse, Church, Kerr & Co., New York.

Mr. Nicola Tesla, in a communication to a daily paper, criticized the equipment of the New York Subway very unfavorably, which drew forth the following reply from Mr. L. B. Stillwell, the electrical director of the Interborough Company: "My recollection of what Mr. Tesla has done for electrical progress in the past is so vivid that I am disinclined to comment upon his technical suggestions, which perhaps appear more plausible to the average reader than to the engineer. I would suggest to Mr. Tesla, however, that a paper from him containing specific and definite criticism of the electrical equipment of the Subway might be presented before the American Institute of Electrical Engineers, and that if he will present such a paper I shall be glad to meet him upon such an occasion for the purpose of a full and frank discussion."

An examination will be held on December 13 by the New York State Civil Service Commission for an assistant electrical engineer. Applications for these examinations must be made on or before November 28. Particulars of the examation and blank applications may be obtained by addressing the chief examiner of the commission at Albany.

A cable dispatch from Berlin, November 20, states that at the 25th anniversary of the Berlin Electrical Society (November 22), Wilhelm von Siemens will present his latest invention, the vanadium glow lamp, which, it is said, will create a sensation in electrical circles. The society will confer on Herr von Siemens a medal, the first of a series to be granted every five years for the most notable electrical achievement during that period.

Charles T. Yerkes, the London underground railway magnate, arrived in this city a week ago, and was much interested in New York's new subway. After hearing about the experiences over here he talked about subway conditions in England. "The English people," he said, "have been riding underground 35 years and in steam cars, the result being that the air is very noxious. The line that we have contracted to equip with electricity is a shallow tunnel the same as the New York Subway. When the substitution is completed we expect to get rid of all those noxious gases."

The Navy Department at Washington, D. C., has authorized the commanding officer at the torpedo station at Newport to accept dispatches to and from ships at sea by way of the Nantucket Lightship. Orders are being prepared opening to commercial business the following naval wireless telegraph stations: Portsmouth, N. H.; Cape Ann, Mass.; Boston and New York Navy Yards; Cape Cod; Montauk, L. I.; Navesink, N. J.; Cape Henry, Va., Dry Tortugas, Fla.; San Juan, Culebra; Yerba Buena, Cal., and Mare Island Navy Yard. Other stations will be opened in a few weeks.

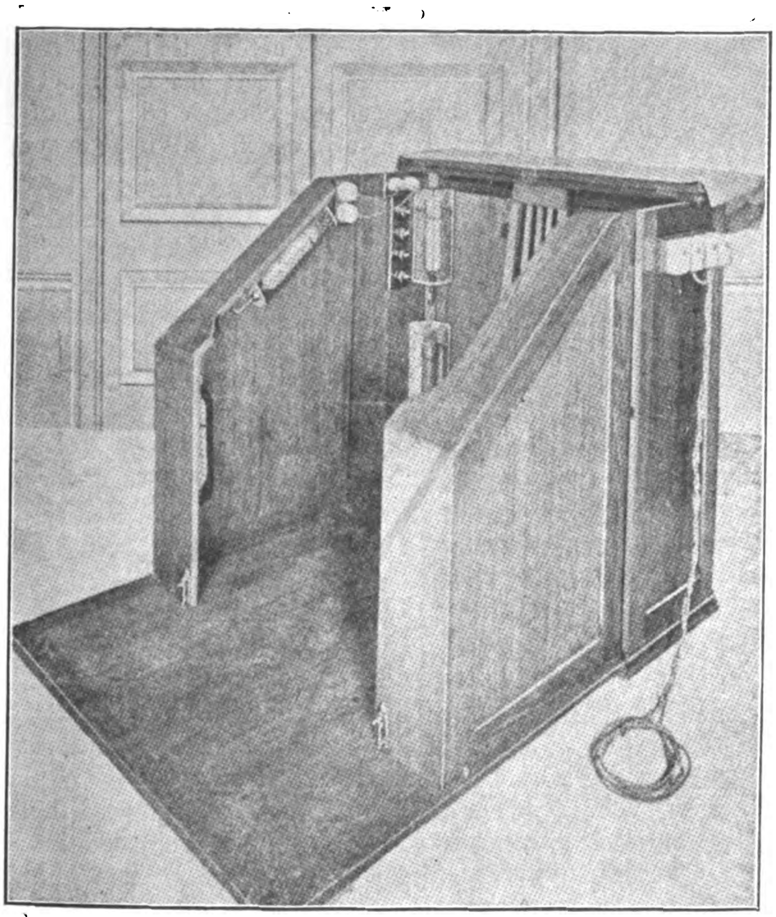
ELECTRIC BATH TREATMENT.

(From our London Correspondent.)

The practice of electro-therapeutics, which was for years placed at a serious disadvantage in England because of the multiplicity of electrical belts and other nostrums which had been used for getting money from the pockets of an all-too-gullible public, seems to have passed through the unfortunate shadow thus cast. The exposures of these frauds, which took place in London between eleven and twelve years ago, and were recorded in ELECTRICITY at that date by the writer of the present article, were successful in showing the general public how necessary it was for them to be on the alert lest they should be allured by attractive advertisements and duped, but it seems to have been almost inevitable that those thus warned should come to regard everything in electro-medical science with suspicion. Some who were legitimately engaged in sound electro-medical work at that date suffered severely, but quite undeservedly, from this cause.

The years that have passed since then have slowly, but it would seem surely, been encouraging a greater confidence and clearing away the excessive suspicion. And with the awakening of new interest on the part of the people at large has come again the opportunity of the quackery vendor; the opportunity has been embraced, though I do not think there is that degree of prosperity that there was in the years preceding the exposures. But I do not propose to dilate at length here upon the electric quack and his wares, only in passing I would drop an expression of amazement that more energetic measures are not adopted wherever he abounds to suppress him with the strong arm of the law.

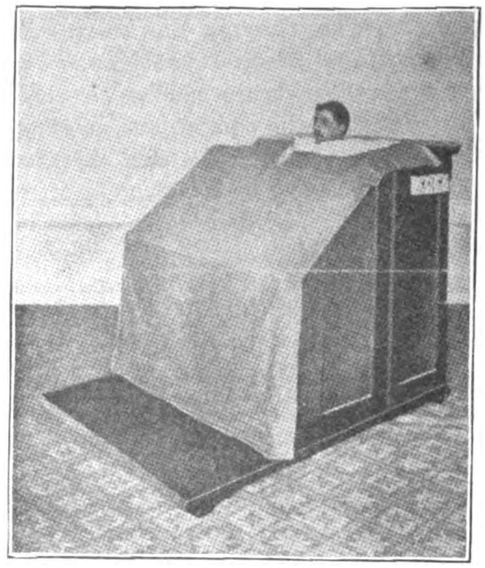
The discovery of the Roentgen rays and the great assistance that they have rendered to surgeon, doctor and many thousands of patients in hospitals, on the battlefield and in private houses, have certainly been among the great educational factors. The splendid work of Finsen, too, in later years, has had a fascination all its own with which to appeal to the public to shake off its apathy toward electricity as a curative agent.



The "Solarium" or Electric Sun Bath.

I may mention two of the latest evidences that exist in London of increasing interest. One is the success of the Dowsing radiant heat and light treatment for diseases of the heart, rheumatism, lumbago, sciatica, gout, etc.; and the other is the establishment of some new baths in London in the neighborhood of Regent's Park, on the Stanger system.

The Dowsing system of electric sun baths was first applied on a large scale at Bexhill-on-Sea, because of its character as a health-giving resort. Among the many advantages possessed by light treatment may be mentioned the fact that there is freedom from perspiration, and also the elimination of waste products by perfectly dry heat. Each bather occupies a separate room, and has the option of regulating the temperature of the bath at will to suit his own requirements, while he can also apply greater heat to any one particular portion of the body more than another at the same moment. The Dowsing "Solarium," as the bath is called, does not depend upon the heating of the air only, as direct light and heat rays are thrown upon the body from special electric heaters fixed in the cabinets. Patent reflectors are employed to direct the light and heat rays upon the person, and means are provided for heating the air as well. Wherever electricity is available in the house the wires can easily be connected to a plug and socket connection to run the bath. The electric current used is about half a unit, according to the length of application, and a 15 minutes' bath is ample in most cases. The "Solarium" cabinets are made to work on any voltage from 50 to 250, either alternating or continuous. We show a cabinet open ready for use; when not in use it has the appearance of an ordinary cupboard.



Taking the "Solarium" Bath.

The Stanger electric bath to which I have made reference is on the same principles as are baths which the inventor, a German electrician, has already established in other countries. These principles are: The localized application of a direct current, and the use of tannic acid in solution in the water, which is maintained at a temperature of 90 to 105 deg. F. The current is applied at pressures up to a maximum of 25 volts, and up to a strength of 3 or 4 amperes, according to requirements, by means of a series of

carbon plate electrodes, which are supported along the opposite sides of the bath by means of slotted brackets, in such a way that they can be readily disconnected where not required, and disposed so as to localize the bulk of the current at any desired part of the body of the patient, or to lead the current in any particular direction through the body. A small centrifugal pump is provided, with which a current of water can be directed upon any part of the person, and an electrode contained within the flexible pipe used for this purpose enables an electric current to be applied therewith.

THE ORLING-ARMSTRONG ELECTRO-CAPILLARY RECORDER.

BY A. FREDERICK COLLINS.

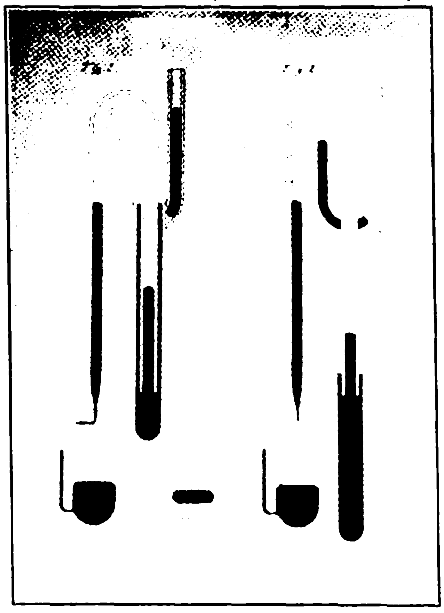
When the first trans-Atlantic cable was laid in 1866 it was found that the speed with which signals could be transmitted and received was at least twenty times slower than over a good aerial line of the same length, and hence improvements were in order to cut down the limitation imposed by the new conditions, and formed not only at that time, but ever since, a desirable field for testing the ingenuity of inventors.

In order to attain and maintain a high rate of transmission it is obvious that the impulses of the electric current must not only be of sufficient strength but must follow each other in rapid succession, both of which is easily accomplished over aerial wires, but in submerged cables there is a retarding effect due to the increased electrostatic capacity.

The retardation of a cable having a high electrostatic capacity is the result of charging the line before a corresponding difference of potential can be set up at the opposite and distant end; it should also be borne in mind that the longer the cable the greater will be the length of time required to charge it, since its capacity increases with its length. Now in virtue of these conditions it is at once evident that the smaller the difference of potential required to indicate a signal the more rapidly will it be possible for the cable to be charged and therefore the faster the signals transmitted.

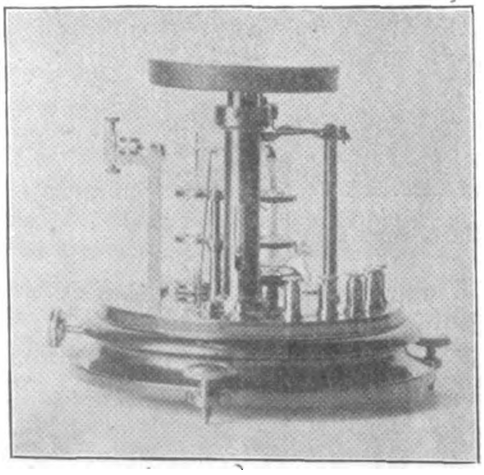
These being the facts in the case, if the receiving instrument employed is capable of being actuated by an exceedingly small difference of potential the duration of time the potential difference must be maintained will be rendered much shorter; these factors permit high-speed signaling to be attained since very low potentials may be employed, and assuming that the receiving instruments have a high degree of sensitivity and the electromotive force an exceedingly low value, the length of time of its application may be reduced to a minimum.

The first improvements to overcome the Leyden jar effect of the Atlantic cable



Figs. 1, 2 and 3 Shows Method of Adjusting the Normal Position of the Meniscus.

were made by Mr. Whitehouse, who ascertained that the speed of propagation of an impulse could be greatly accelerated and increased by alternately connecting the line with the zinc and copper elements of the battery; Sir William Thomson, now Lord Kelvin, then found that impulses of properly proportioned lengths rapidly succeeding each other were even

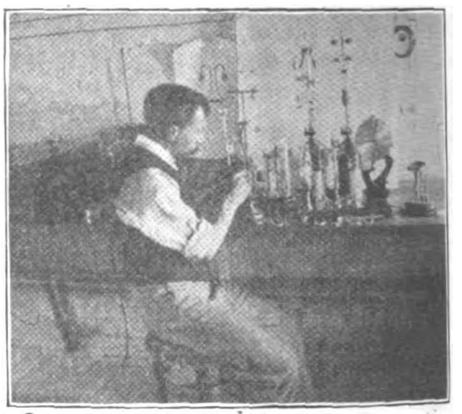


Electro-Capillary Recorder.

more efficient, and for producing the desired results he devised his automatic transmitter.

The earliest receiving instrument used in connection with the Atlantic cable was a reflecting galvanometer, also the invention of Lord Kelvin, and it was largely due to his genius that cable telegraphy finally became the great commercial arteries joining the continents of the world into one articulated whole. Following the reflecting galvanometer Lord Kelvin brought out the siphon recorder, and since the advent of those sensitive and delicate devices there have been numerous others who aided in making the cable speedier, surer and more accurate in the transmission of intelligence.

The latest receiver is the Orling-Armstrong electro-capillary recorder, possessing an extremely high sensitivity, since, unlike the galvanometer, it has no coils and therefore no impedance and practically no resistance, while its moving part consists of a fine thread of mercury, the weight of which is practically negligible. This instrument comprises two dissimilar fluid conductors that will not mix and whose surfaces make contact with each other at a constricted part of the tube; one of these fluids is opaque and the other translucent.

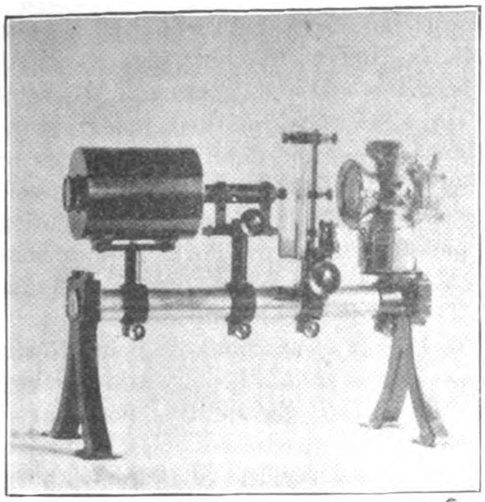


Sending Electro-Capillary Recorder.

On the receipt of signals the tension of one of the surfaces of contact is instantly varied, causing the fluids in the tube to rise or fall according to the nature of such signals. Arranged in connection with the tube is a beam of light which normally falls upon a traveling photographic tape, and when, however, the signals are received this beam is more or less screened by the movement of the opaque fluid, and, as a consequence, a record is produced and obtained photographically.

This electro-capillary recorder responds to extremely small differences of potential, owing to the small mass of the moving parts whose movements are recorded on the tape and the consequent small inertia to be overcome; oppositely the operation of the siphon recorder, now so widely used for long cables, depends on the polarity imparted to a suspended coil by the current received through the cable, which causes it to move in a stationary field and to thus produce a record on a

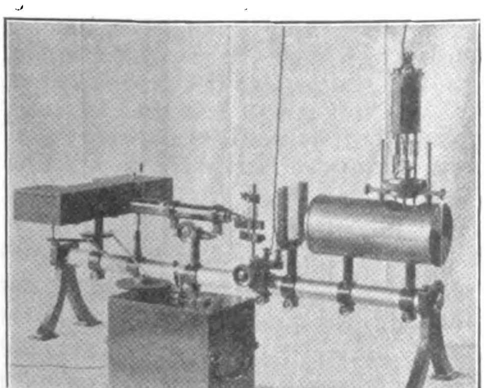
tape. This coil, being several times heavier than the moving part in the capillary recorder, offers considerable mechanical resistance to the small force that is to move it; again, the suspended coil has normally a very slow natural period which must be in beat with the received



Electro-Capillary Recorder for Sight Reading Only.

signals if interference between the swing of the coil and the impulses which are to actuate it is to be avoided.

Now the signals are transmitted as quickly as possible under the circumstances, and in order to avoid this interference, which would prove fatal, the period of the coil is quickened by tightening the suspension. By resorting to this method there is introduced a corresponding disadvantage, since the signals have more words to do. To enable signals to be received more rapidly than they are at



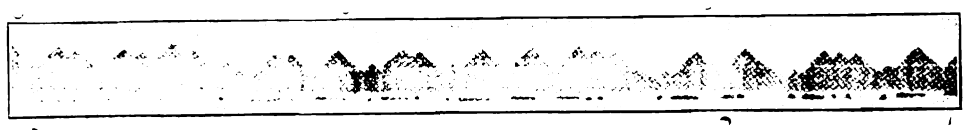
Electro-Capillary Recorder with Photographic Attachment.

present the period of the coil would have to be quickened to a greater extent by increasing the tension of the suspension, which would necessitate a further strengthening of the transmitted impulses.

Again, it has been observed that retardation is greater when strong impulses are transmitted and the logical conclusion is that stronger impulses cannot be transmitted so rapidly, and it would therefore appear that the speed limit of reception by the coil instrument method has been practically reached.

Electrical energy is transmitted along a conductor with a velocity very nearly the same as light, but although some of the energy reaches the distant end almost instantaneously, the greater portion of it is expended in charging the cable, and it takes an appreciable length of time before a sufficient potential difference is built up at the distant end to work the receiving instrument. This done, the cable must be discharged before an impulse of the opposite sign can be transmitted, and this process also requires time.

Under these conditions the more sensitive the receiver is to small changes of potential the more suitable such a receiver is for long submarine cables where high efficiency is required. It may be argued that if the receiver is too sensitive it would be too readily affected by extraneous disturbances and so record unreadable signals, for such is in truth the case with a slow working recorder



360 Words per Minute.

whose curved recorder line has its signals comparatively far apart; but as the capillary recorder permits a very high speed to be maintained the curves due to ordinary disturbances do not seriously affect the legibility of the actual signals.

Owing to the low potential of the impulses used loss by leakage is practically nil, and for this reason the system is well adapted for use where the cable is leaky or badly insulated. One of the most important and difficult of all problems in the domain of electrical engineering is that of utilizing cables laid underground instead of overhead; it has been found quite impossible heretofore to secure this advantage, since one mile of an underground circuit has as great an effect in cutting down the effective transmission as 20 or 25 miles of overhead wire. In practice it appears that 15 miles of underground circuits in New York City cut down the currents as much as 840 miles of overhead circuits, or, graphically stated, it requires as much energy to transmit messages from one end of Manhattan to the other by the underground method as it does to propagate the impulses by aerial wires between New York and Chicago. It is pointed out by the inventors that the electro-capillary recorder would effectually obviate this wide discrepancy.

The electro-capillary recorder has been developed to a high degree of perfection and possesses numerous advantages over all other receivers for not only cable work and long-distance land lines, either underground or aerial, but for wireless telegraph uses as well. For submerged cable work the speed at which messages are transmitted and received by the electro-capillary recorder is double that of any other instrument. The simplicity of the device greatly reduces the amount of attention necessary, and owing to its peculiar sensitiveness it has been discovered that when a break occurs the cable messages may still be received. Since less power is required and it becomes possible to use cables of much cheaper construction a great reduction in the cost of the messages will be effected.

For long distance underground land lines it insures practically against leakage, and where underground lines can be used a great saving in cost of maintenance is effected and freedom from storms is provided, while less power is required and accelerated speed of reception is insured.

In the electro-capillary receiver for Hertzian waves it is so sensitive that messages may be received by it faster than by any other known system, feebler electric impulses may be received, greater distances may be covered, shorter antennæ are required, reliable working is assured, and finally it is a long step toward the solution of syntonic wireless telegraphy in-so-far as the receiver itself is concerned.

ELECTRICITY LEAFLETS.

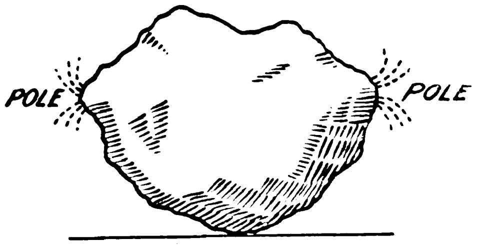
BY NEWTON HARRISON, E. E.

MAGNETISM.

Historical.—The ancients had many legends founded upon the wonderful properties of the lodestone. In the Arabian Nights, a work of literary antiquity, the travels of Sinbad the Sailor, describe the destruction of the vessel in which he and his companions sailed, by approaching too close to a mountain of lodestone. The nails were drawn from the vessel and it fell to pieces. The lodestone was originally found in Magnesia, from which was derived the name magnet. From a

chemical standpoint it may be represented by the formula FeO_3, which means a combination of iron and oxygen, forming an oxide, sometimes called magnetite. This mineral possesses permanent magnetic properties, by which is meant that it has the power of attracting light fragments of iron, and holds them with considerable tenacity. It is argued, that where lightning has struck, in the neighborhood of such ore, there the lodestone may be found in considerable quantities. There is much truth in this statement, but when it is known that powerful earth currents pass unceasingly around the earth, and that the earth itself is a powerful magnet, the reasons become somewhat distributed among these other possible causes as well.

Peculiarity of the Lodestone.—Sir Isaac Newton, the distinguished discoverer of the laws of gravitation, was very proud of a piece of lodestone he possessed set in a ring. It was powerful enough to lift several hundred times its own weight, and in addition betrayed the presence of poles. By this is meant, that at certain points in this mineral, the power seems to be concentrated and this



Showing Poles of Lodestone.

in total may be considered as the chief peculiarity of the lodestone.

Poles of the Lodestone.—By dipping a lodestone into a cup of iron filings, and then withdrawing it, it will be noted that the filings cluster at each end very thickly. This is merely a manifestation of the peculiar property of all magnets whether natural or artificial; that they must have two poles. At these points, as shown by the lodestone an emission apparently takes place, to which the old experimenters gave the name of magnetic fluid, but which in the light of modern science, as interpreting this phenomena, is called a magnetic field.

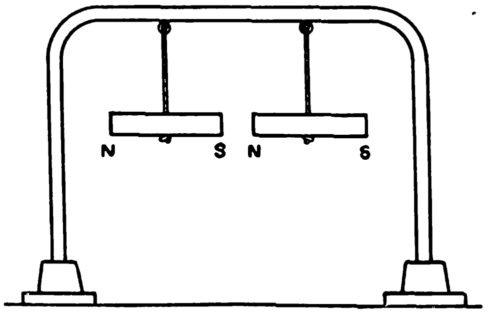
What is a Magnetic Field.—Perhaps no more familiar instance of the presence of a magnetic field can be given, than that of the earth itself. Like the lodestone it possesses poles and similarly sends out that remarkable emanation called a magnetic field. For this reason, reference can be made to both, particularly in regard to the effect of the earth upon a piece of lodestone suspended by a light thread. In this case the lodestone will slowly swing, until it has assumed a certain position, to which it will inevitably return, no matter how often displaced.

This shows clearly, that the earth exercises a directive effect upon a lodestone, and in consequence the end of the lodestone pointing north has been called the north pole.

A Magnet's Poles.—It has been stated on good authority that lodestones have been used by the Chinese for many centuries as compasses or guides to the geographical north. Whether this be correct or not, it is well known that by rubbing a piece of tungsten steel with a lodestone, the magnetic properties of the lodestone are imparted and the steel will act in all respects as the lodestone itself. It will possess poles, and naturally a magnetic field. If properly mounted, it will swing around and point north, and in fact becomes an indispensable agent of civilization, namely, a compass needle.

If the end of a magnet pointing north is called a north pole, it is but a step to conclude that the other end must point south, and will be called a south pole. From this conclusion arises a line of demarkation between the two poles. But based upon another system of reasoning, some of the properties of these poles are considered and in this respect at least become known to the scientific world as a north and a south pole.

If two pieces of steel are magnetized, and so mounted as to swing freely, they will turn so as to present opposite poles to each other. It is useless to attempt to



Swinging Magnets Seeking Opposite Poles.

turn them from their positions with regard to each other in this respect. They will inevitably return to the position which brings the north and south pole nearest to each other, and in fact betray a repulsive force when the attempt is made to place them otherwise.

Laws of Magnetic Poles.—This has led to the discovery of the fact that certain laws operate, which may be stated in the following manner:

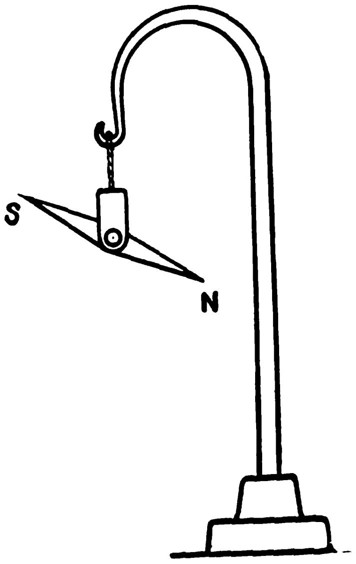
Unlike poles attract each other.
Similar poles repel each other.

On such a basis as this it is possible to construct a system by which magnetic phenomena may be explained in so far as they lie within the scope of these laws.

It has therefore become a matter of argument as to which is really the north pole of a magnet with respect to the earth. According to the above laws the end of a magnet pointing north would be a south pole, as this is the only pole the north pole of the earth could attract. By some it is called the "marked pole" or the "blue pole," and finally it is termed by others, rather sensibly, the "north seeking pole." The navigator and scientists in general call it the north pole in spite of this fact, and in this manner it shall be so regarded in the future.

The Geographical and Magnetic North.—Lest there should be any misapprehension regarding the relative positions of these entirely dissimilar poles, it may be stated at once that the geographical north pole of the earth is a geometrical point on the earth's surface, so far untrodden by the foot of man. On the other hand, the magnetic north pole has been reached somewhere in the neighborhood of Hudson Bay, Canada.

Dipping Needle.—A magnetic needle supported on a horizontal axis becomes what is commonly known as a dipping



Dipping Needle.

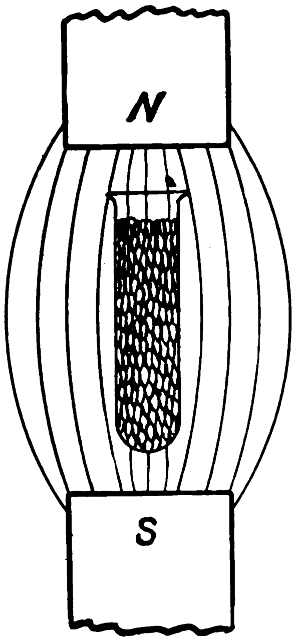
needle. At the equator the needle would practically have no dip. But as it is moved north or south a few hundred miles either the north end or the south end begins to dip. If moved north until it approaches the magnetic north pole, the dip becomes very pronounced, and if placed over the magnetic north pole, the north pole of the needle would point directly down. From the standpoint of practice and utility, however, the movement of the needle as a compass in a horizontal plane is of the most direct im-

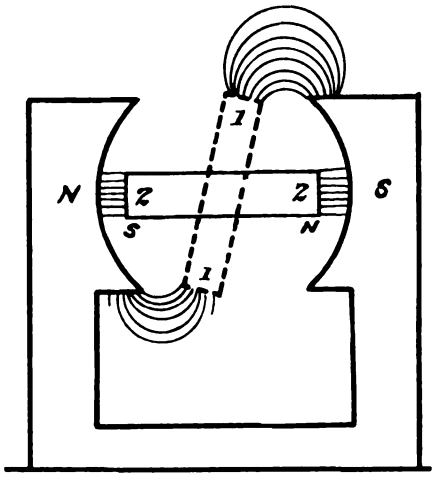
portance. In navigation, allowance is made for the difference between the magnetic and geographical north in steering a vessel.

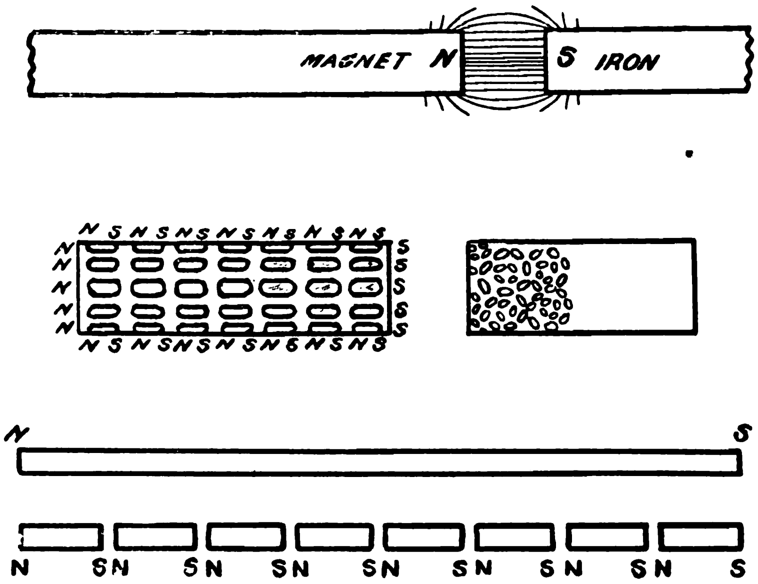
Magnetic Induction.—If a magnet is held near a piece of iron, even though no contact takes place, the piece of iron develops poles. The influence of a magnet upon a neutral piece of iron or steel is called magnetic induction. This explains the attraction which results before contact takes place, and also shows how such attraction can be explained in the light of the law which states that unlike poles attract each other. If a piece of hardened steel is thus exposed to the influence of a magnet it becomes permanently magnetized, that is to say, it will retain its magnetic properties after the source of magnetism has been removed. A piece of soft wrought iron will not hold its magnetism like steel, therefore as both can exhibit magnetism, in the one case temporarily, and in the other case permanently, they are called permanent magnets and temporary magnets.

Theory of Magnetism.—The theory of magnetism is based upon the idea that it is a molecular phenomenon. The molecules of iron and steel differ in this respect, that when the molecules of steel are disturbed by magnetism, they are not free to move back to their original position, whereas in the case of wrought iron, they possess this power. The illustration conveys this idea adequately, but the molecules must be regarded from another standpoint as well. According to this theory, and an experiment about to be described bears it out very completely, every molecule of iron and steel, is by nature a magnet. The means by which this idea is proven is as follows: A long steel needle or wire is carefully magnetized and its poles tested by a compass needle. They will be found to be north and south. The needle is cut in half and then tested. Each half will be found to possess a north and a south pole. A repetition of this process will reveal the fact that every piece of steel has become a magnet with two poles. If one of these pieces of steel is supposed to be divided and subdivided beyond the practical limits possible, a point is reached where a molecule of steel is obtained. This molecule, according to all experiments preceding its appearance, must possess a north and south pole. With regard to this polarized molecule, it may he said that it is indispensable at present in relation to the explanation it gives of most of the magnetic phenomena observed in connection with iron or steel.

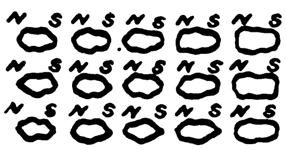
Test Tube of Iron Filings.—If a test tube is filled with iron filings and exposed to a magnetic field the filings will arrange themselves in an end to end manner, each particular grain of metal placing itself so as to bring its opposite poles in contact with the opposite poles of its neighbor. When removed from the magnetic field the filings, of course, become disarranged. The experiment seems to indicate that magnetism in iron or steel is equivalent to a certain position of the molecules. If a piece of iron or steel is unmagnetized the molecules are irregularly arranged, that is to say, they do not point end to end throughout the length of the iron rod. In fact, the molecules are arranged in small closed magnetic circuits which effectively shut off all external signs of magnetism from the body as a whole. These rings of magnetic elements are composed of what are called polarized molecules, that is to say, infinitesimal permanent magnets, whose natural position is that illustrated in the sketch. When the magnetic field affects them, however, they are torn or forced from this position and arrange themselves as shown. By this means one end of the bar becomes north and the other end south, and it is easy to see that the fracture of the bar at any point whatsoever would result in

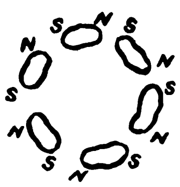






A top figure, B and C center figures, D bottom figure.
A—Iron Magnetized by Induction. B—Molecules Magnetized. C—Molecules Unmagnetized. D—Steel Wire Magnetized and Each Fragment a Magnet.





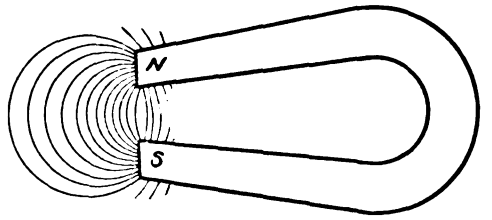
A and B upper figures; C and D lower figures.
A—Test Tube of Iron Filings with Filings Magnetized. B—Iron Bar Forced from Position 1, 1, to 2, 2, its Poles Due to Induction, its Lines of Force Parallel to those of the Field. C—Arrangement of Molecules in a Magnetized Piece of Iron or Steel. D—Arrangement of Molecules in an Unmagnetized Piece of Iron or Steel.

opposite poles appearing, each at the respective ends of the fractured section. Therefore, when a permanent magnet is broken in half, two magnets appear; if broken again, four magnets are in evidence, etc.

Principle of Magnetism.—One of the most useful of magnetic principles is that which states that "lines of force tend to set themselves parallel to each other." This principle is clearly shown in the repeated efforts of a compass needle, when diverted from its normal position by the finger or another magnet, to return to one in which its lines of force lie parallel to those of the earth. If a bar of iron is held almost at right angles to the magnetic field of a powerful magnet, the tendency of the field to twist the bar around is due to this principle and also the fact that the poles in the bar induced by magnetic induction are thus brought closer to the poles of the magnet.

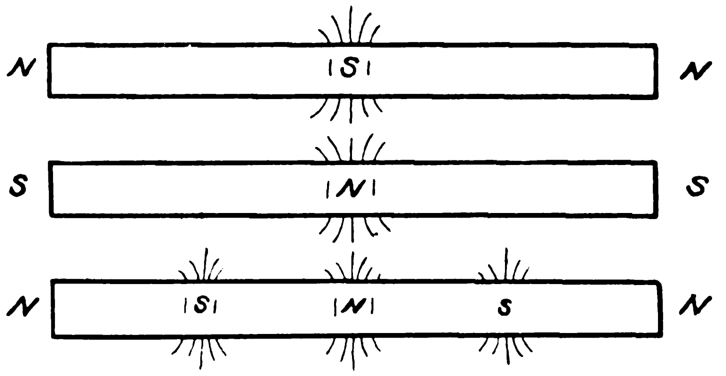
Consequent Poles.—It is generally supposed that a magnet can only have two

Under this circumstance, very little, if any, magnetism can be detected outside of the magnet, and it constitutes in this form, as before stated, a closed magnetic



Lines Radiating from Each Pole and Repelling Each Other.

circuit. The lines of force emanating from its poles and sides follow a curious curved path. This picture can be readily observed by placing a sheet of paper over the magnet and sifting iron filings above. When they fall, they will arrange themselves in curved lines showing the direction of the magnetic field. At each individual pole they repel each other, because, according to the two laws, north lines repel north lines and south lines repel south lines. But they curve around



Magnetized Bars with Consequent Poles.

poles but this is not so, as shown by the sketch. Here the magnet has two north poles or it may have two south poles. This would give either a south or a north pole in the middle of the bar. Such a pole is called a "consequent" pole and is, as shown, a pole belonging to each of the magnets of which it constitutes a part. This shows that a magnet as thus understood is not necessarily a bar of steel or iron with a pole at each end, as such a bar may really consist of several magnets, depending upon the magnetization of the bar. For this reason the distribution of the magnetic field must be ascertained and investigated by means of a compass needle, otherwise it would be very confusing to find similar poles at the two ends of a magnetized bar.

Horseshoe Magnets.—In order to obtain in full the effect of the two opposite poles a bar magnet is bent around, forming the familiar type of the horseshoe magnet. This magnet is supplied with an armature of soft iron which is generally left in contact with the poles when not in use.

in spite of this repulsion and meet each other according to the law that the lines of force of opposite poles must attract each other.

THIRTY-THOUSAND-VOLT TRANSMISSION.*

BY J. F. KELLY AND A. C. BUNKER.

In discussing the conditions which affect and limit the constants and operation of high tension lines, pressures of over 30,000 volts and lines of over 50 miles in length only will be considered.

The difficulties of taking care of lightning discharges increase much more rapidly than the line pressure, for the reason that any disturbance or change in circuit conditions, produced by getting rid of or dissipating a charge in a circuit having high voltage and high inductive and capacity reactances, may set up oscillations which, if not serious to apparatus, are disastrous to regulation and service. Various combinations and multiples of low voltage types of arresters have been used, but where these have not had the proper addition of a resistance, they have seldom failed to be completely destroyed when the particular stroke or circuit change occurred. It has been clearly shown that the same arrester could not, without special adjustments, be used on all parts of the circuit, and that arresters performing their function for a lightning stroke, or taking the kick-back from a short-circuit opening, when a given number of generators, length of line or transformers were in circuit, would not so operate for another number of generators, transformers or length of line. This may have been due to the increased inductance in circuit obtained from a smaller number of generators or transformers, to a longer length of line, to the nature and duration of the arc in opening the short circuit, or to any number together of these conditions. Where a resistance is used with any type of arrester, in order to keep the value of current which would flow over the arresters to a given percentage of the load current, the amount should be such that five or six times the normal impressed voltage can be taken care of.

A modified form of the Siemen's arrester has been used on circuits up to 50,000 volts with a fair degree of success when they were correctly adjusted for the different positions of the circuit, and, where a resistance was placed in series, the voltmeter cards were not painted badly when lightning or a short-circuit occurred. This design can be greatly improved, and no doubt would give very good results and thoroughly protect connected transformers. The low cost, ease of construction and their outdoor service ability are points in their favor. Perhaps the most reliable arrester is one consisting of an inductance and capacity in parallel, so that any frequency variation from the normal would cause a certain value of current to flow. This type, immersed in oil, would be rugged, and could easily be adjusted for any position of the circuit.

One of the best means of dissipating an induced charge or stored energy in a line is by having a distributed load along the circuit. If this load has a grounded neutral, the effect of a lightning stroke will be greatly reduced and more easily taken care of by the regular arresters. The star-connected line with grounded neutral has, however, some disadvantages of equal importance, which should

*Abstract of a paper on "Some Difficulties in High-Tension Transmission and of Methods Mitigating Them." read before Section D of the International Electrical Congress, held at St. Louis, Mo., Sept. 12-17, 1904.

be carefully considered before being adopted.

When a line is short-circuited from any cause, there is a rush of current, the value of which depends upon the impressed voltage and the impedance of the circuit up to the point of the short-circuit. When this current is suddenly interrupted, the voltage induced depends upon the constants of the circuit and increases in value with the length of circuit, distance between wires, the amount of inductance of the connected apparatus, the inductance of the rupturing arc and its duration, the impressed voltage and the instantaneous value of the current when the short circuit is opened. This induced voltage will be small or of little importance if the short circuit is opened at or near the zero value of the current. In operation, induced voltages have been observed when opening a 40,000 volt 100-mile line when short-circuited, of from two and one-half to six times the normal voltage, as measured by the length of air-gap broken down by the kick-back.

The troubles from the charring of wooden pins were due to the continual leakage of current over dust-coated insulators. In some localities pins would only last from one to three months. This was entirely corrected by placing a metal short-circuit around the pin. Moulding at the thread, which is often noticed where the line passes through a marsh, can be prevented only by the use of a metal pin. Several lines have now been equipped with steel pins, and no new troubles have developed. It would seem that for large high-pressure lines steel pins should be used exclusively. Their initial cost is from one and one-half times to twice the price of wooden pins, though cheaper in the end. Soft lead gives better results for the thread than any composition. The moulds should be made so that enough lead can be used to extend a little way below the bottom of the thread, as this will give a good bearing to the insulator over and above that obtained from the thread. This will greatly add to the mechanical strength of the insulator and of the line, as, with the ordinary pin, the insulator is the weakest element of the line. Precaution should be taken to have the thread portion short enough so as not to come in contact with the top of the insulator. This will prevent the tops being forced off when the insulators are put on the pins, and will allow a firm seat at the other end of the thread.

The idea that poles of the right kind of wood for the soil can be placed in the ground and last for 10 or 20 years has been the cause of many and costly repairs. One 6-year-old redwood line, with butts treated before raising, had to have 33 per cent. stubbs. Another redwood line, untreated, had to have 10 per cent. stubbs in three years. Another line of untreated cedar poles required 35 per cent. stubbs in six years. In long lines, and even in some short ones, soils may be found that have an entirely different effect upon the life of the same wood.

The burning of the poles at the ground has been the cause of interruptions even when the line was patrolled twice a day, but the remedy is simply a question of persistence and expense in keeping the right of way cleared of all growth. It might be noted here that, even with a generous right of way kept cleared, the wind may carry the heat from a fire toward the line.

One case is known where some dried hay was carried up into a 40,000-volt line, with the result that it was set on fire and produced an arc that shut off the power. The burning hay, being carried on by the wind, did considerable damage. On another line, a flock of pelicans flew into the telephone circuit, which was strung several feet below the power wires. The span was something over 600 feet, with a sag of 19 feet. The telephone wires were struck so hard as to wrap them around the power circuit. In another case a long piece of light bark was blown across a 42-inch line, with the usual result. On the same line, during one season, there were three interruptions in one locality, caused by large birds getting across two of the wires.

One of the principal advantages of wooden poles is that, in case an insulator is broken, allowing the wire to come against the arm or pole, the burning which takes place almost immediately in most cases may continue for several minutes before a blaze will start which will short the circuit. Several times it has been observed that from 20 to 30 minutes elapsed from the time trouble was first noted by the ammeters or telephone until it was necessary to shut off the circuit. In one case a 40,000-volt (grounded neutral) lay on a dry cross-arm for several hours before the circuit could be shut off, and at the end of the time the arm was not badly charred. With a duplicate line, ample time would in most cases be given for changing from one circuit to the other, or to cut out the affected circuit, providing the telepone line was operative or the men at both ends recognized the difficulty. For the past four years, engineers have tried to adopt, where possible, steel towers, instead of wooden poles, as a means of correcting a large number of line troubles.

At first thought, towers would seem to solve all difficulties previously experienced and certainly do eliminate a great many. The spans can be increased, so that as low as eight towers per mile can be used with safety. This would greatly reduce the number of insulators, which can be larger, and the means for their attachment to the towers can be quite elaborate without exceeding the cost of the other construction. The height of towers can be greater, which will decrease troubles from wires, branches and other material being thrown or blown across the circuit and reduce the breakage of insulators from the heat of forest or grass fires. If galvanized or painted occasionally, their life would be greater than could be expected of wooden construction. Towers can be erected in places even more difficult of access, since they can be taken apart in pieces of lighter weight than a wooden pole. They would offer a more or less good lightning path to ground which would help to prevent the injury to connected apparatus, but will no doubt subject each insulator to greater strains. Any leakage around, or puncturing, an insulator will mean the immediate shut down of the circuit, and, in order to prevent the shut-down of the entire system, overload and reverse circuit breakers of the best possible design will have to be used.

The distance between wires is usually determined from the highest voltage which can reasonably be expected as a limit, as determined above. The rule that the distance between wires in inches equals one and one-half times the number of thousands of volts is safe so far as the striking distance is concerned, though to correct for arcs holding on for a time after once established would be impossible. Where the cost of erected poles is high, or the right of way expensive, two circuits per pole line should be used, and, with good wooden construction, mechanical difficulties would limit the distance between wires to at most 60 inches, which would allow a line voltage of, say, 50,000 or 60,000. This distance between wires is for spans not over 150 feet to 200 feet. A number of spans over 600 feet in length have been in operation for two or three years. These have been closely watched during wind storms to see what deflection would be given to the wires. Three aluminum cables $\frac{5}{8}$ inch in diameter, 600 feet span, 19 feet sag, were deflected from 30 to 45 deg. from the vertical by a wind that was estimated to be 70 miles per hour. All three conduc-

tors kept their relative position when deflected, and there were no perceptible waves or vibrations in the cables.

It is claimed by some who have had the opportunity to notice, that in longer spans there is less tremor, vibrations or waves passing over the span when there is a wind than when there is none. All observations of the writers show that, for spans of 600 feet at least, there is no tendency of the wires to swing together in ordinary storms. Where possible the frequency of the current transmitted should not exceed 30 cyles per second. With the general use of alternating current railway motors, 15 cyles or less may be advisable. With two circuits, one should be transposed in the opposite direction to the other, although there is one double circuit line operating satisfactorily as far as the telephone is concerned, with one of the circuits run straight through. Experiments made with a power line without transpositions and a telephone transposed every fifth mile placed 5 feet below the power wires, gave a pressure to ground of from 2,100 to 2,800 volts when the line pressure was 40,000 volts. With 30,000 volts the telephone voltage to ground was reduced in the same ratio. By giving the power wires two-thirds of a rotation between power taps and talking points, this voltage was not readable on a Weston or hot-wire 150-volt voltmeter. The induced voltage was due to capacity, and in none of the tests was there any measurable electromagnetically-induced voltage. The large number of fatal accidents which have occurred in the past from the telephone circuit being placed on the same poles with and under the power wires, would warrant a separate pole line, even if the service were no better.

A telephone is most needed at times of line disturbances, and at such times it is rarely of service. The induced voltage on a telephone circuit, even where power line transpositions are made, when one or more of the power wires are out or grounded, is high enough to be dangerous to life and to set fire to adjacent woodwork. The distance between the two circuits should be at least 6 feet, and 8 feet would be better. In stringing the telephone wires the same sag should be given as to the power wires. For lines over 50 miles in length, copper or aluminum should be used. All breakers and switches should be provided with cut-out switches on each side, so that they can be taken out of a live circuit for repairs.

Chili is to have a system of wireless telegraphy.

ORE FINDING BY ELECTRICITY.

One of the latest appliances of electricity is to make it the means of discovering lodes, reefs or strata in the earth's crust that contain metals. Its efficiency for that purpose has now been demonstrated, and we propose to explain in the simplest possible language, stripped of all technicality, the manner in which the finding of ores by electricity is accomplished. In some respects the process employed resembles wireless telegraphy, with the difference that in this case waves of electrical energy are sent down into the solid earth, whereas Mr. Marconi's impulses are projected into space. It is now well known that if a current of electricity be put into the earth at any spot it can be made perceptible at a considerable distance away. If there were a wire connecting the two places the current would run along this conductor; it could be perceived at any part of it and scarcely at all elsewhere.

But the remarkable fact is that, if there be no wire or conductor, the electrical force or energy will be radiated in all directions, not only over the surface, but also downwards to a considerable depth. This is the first of the two simple principles on which scientific prospecting is based. The second, equally simple, is that, while earth and rock materials generally allow the passage of electricity through them in a regular and fairly constant manner, certain kinds of rock do not; some carry the electricity along with ease, and are, in fact, conductors, while others resist its passage, and are non-conductors. All the metals practically come into the first class—they are channels along which electricity passes with ease; while quartz, the great gold-bearing rock, comes into the second category—it offers, like glass, great resistance to the electric current. Hence the problem of the ore-finder was this—to throw into the ground electrical impulses, and by noting how these affected the strata beneath, to find out whether there were metallic veins, or lodes. The manner in which that problem has been solved is as simple as the principles on which the solution rests.

We have said that if electrical impulses are sent down into the earth at any spot they can be perceived at a considerable distance away. The current put in at one place can be picked up, as Professor Silvanus Thompson puts it, at another; and there exists one marvelously delicate means of doing this, with which everybody is now familar—the telephone. Suppose we fix into the earth a copper rod connected by a wire with an electric battery, and a wave of electricity is passed into the ground. The effect on even the first cubic foot would be slight, but how minute must be the effect over half a mile square, and at a depth of 200 feet or 300 feet! Yet every single particle of earth and rock within that space feels the thrill. The telephone enables us to hear it. The late Professor Tait calculated that the current which works the telephone is about a thousand million times less than the current used in ordinary telegraphic work, and in virtue of that amazing quality these infinitely small electric waves can be heard. To the trained ear of the electrical prospector these sounds bring the intelligence whether there are conducting metals below or not.

Suppose we have two operators; one is sending electric waves into the ground, the other with a telephone receiver to his ear listens to a succession of quick taps—like a woodpecker tapping at a tree. If these are regular and normal nothing is to be said, but if there are over or under tones, if the sounds rise and fall in certain directions, then there are metallic conductors, lodes or reefs present, ores in some shape or other that are producing differences in the waves and sounds. The expert listener can judge with surprising accuracy how deep the lode is and in which direction it runs. The apparatus by which this result is rendered possible is the invention of Mr. Leo Daft, an American, and Mr. Williams, an Englishman. It is extremely ingenious, and in the hands of experts admits of the most delicate manipulation. The essential principle of its working is that it emits not a continuous current, but a series of little, short, sharp impulses; these go forward in all directions, and when they meet with quartz-rock or metallic lodes the waves are so modified that the listener can form a judgment where the ore-bodies causing the variation of sounds are situated.

This has now been fully demonstrated in regard to the metals galena and zinc, lead, copper, hematite, magnetic iron, nickel and cobalt, gold and silver. The location of hematite deposits a few days ago in the Barrow district proved the efficiency of the process, and was in every way a gratifying success. That part of the country is one of the best remaining for the production of this valuable ore, but for some years past the yield has been falling off seriously. The Barrow Hematite and Steel Company therefore made a trial of the electrical ore-finder. An area was allotted for the experiment, and in a very short time electrical evidence was

obtained of the presence of hematite, and apparently in considerable quantities.

The apparatus indicated the position of the deposits, and this was done so accurately that when the Barrow Company put down a bore hematite was found at about the depth adjudged, and the discovery is likely to prove of great importance. In a similar way, with variously attuned apparatus, gold has been located in Alaska and Siberia, lead in Wales, copper in Cornwall and at Coniston, and the other metals we have named in various parts.—"London Daily Telegraph."

Light Another Form of Electricity.

A cable dispatch from Berlin, November 17, says that at the meeting of the German Society of Naval Architects Prof. Braun, of Strassburg, the well-known inventor of one of the German wireless systems, asserted that he had recently proved "that light was only another form of electricity, as physicists had already anticipated." In establishing this point the professor said he had discovered structures in vegetable and animal tissue hitherto unsuspected, which are visible only by means of microscopes of the utmost intensity.

Big Assemblage of Scientists.

As the guests of the University of Pennsylvania the American Association for the Advancement of Science and 40 other scientific societies national in their scope, will hold their annual conventions at the University in the Christmas holidays. Fully 1,500 persons are expected to attend the conventions. The principal meeting will be that of the American Association which celebrates its 54th anniversary. It has met in Philadelphia twice before, but never as the guest of the University of Pennsylvania. Carroll D. Wright, Commissioner of Labor, is the retiring president and he will deliver the annual address. The incoming president is Dr. W. G. Farlow, of Harvard University. The meetings will begin on December 27 and continue until December 30.

Allis-Chalmers Company Reports Good Business.

According to an official of the Allis-Chalmers Company the company's business is improving at a splendid rate. New orders doubled during October as compared with September. It is expected that November will make a relatively larger showing compared with October.

Ohio Engineers Meet.

The ninth meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held at Canton November 18 and 19. The following papers were read: "Some Facts and Features About Electric Meters," by H.S. Fashbaugh; "Notes on Solenoid Electric Mechanical Governors, as Applied to Turbines and Impact Wheels, a New Departure on Water Wheel Governors," by Frank S. Replogle;" "Boilers and Furnaces," by W. C. McCracken; "Gas Engines in Power Plants," by Prof. William T. Magruder; "Electrically Driven Chapman Valves," by Herbert E. Stone.

PERSONAL MENTION.

Mr. John J. Stanley, present superintendent of the Cleveland Electric Railway Company, is to resign and accept the position of general manager of the West Shore traction property in New York State, becoming its real operative head.

Mr. Thomas Ferris of Milwaukee, who for 12 years has represented in Wisconsin the Chicago headquarters of the General Electric Company of Schenectady, N. Y., has resigned to become the manager of the Electric, Light, Heat & Power Company of Osage, Ia.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOV. 15, 1904.

Electric Railways and Appliances.

774,896. Electric Safety Apparatus for Cars or Trains. William P. Robertson, Bronxville, N. Y. Filed May 12, 1904.

774,897. Block-Signal System for Electric Railroads. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Filed Dec. 7, 1903.

774,983. Car-Fender. Charles Goehring, Brooklyn, N. Y. Filed May 21, 1904.

775,276. Trolley System for Overhead Electric Lines. James B. Kline, Warren, Pa., assignor of two-thirds to Starling W. Waters and Charles E. Metzgar, same place. Filed Feb. 1, 1904. Renewed Oct. 19, 1904.

Electric Lights and Appliances

774,749. Portable Electric Light. Edwin R. Gill, New York City, assignor to the Electric Contract Company. Filed Jan. 25, 1902.

774,789. Electric-Arc Lamp. Ralph Scott, Wilkes-Barre, Pa., assignor of one-half to Marcus A. Miller, New York City. Filed Oct. 14, 1903.

774,812. System of Distribution for Electric Glower-Lamps. Alexander J. Wurtz, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Nov. 9, 1900.

774,836. Vacuum Arc-Lamp. Hubert Emonds, Aix-la-Chapelle, Germany. Filed Jan. 30, 1904.

774,876. Electric-Arc Lamp. Thomas Hamilton-Adams, London, Eng. Filed Aug. 21, 1903.

Electrical Machinery and Apparatus

774,758. Electric Spark-Gap. Thomas B. Kinraide, Boston, Mass. Filed May 25, 1904.

774,782. Power-Transmitting Mechanism. Lynn D. Robinson, Binghamton, N. Y. Filed Jan. 22, 1904.

774,800. Controller for Electric Motors. Hermon L. Van Valkenburg, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 14, 1904.

774,815. Electric Indicating Mechanism for Pressure-Gauges. James P. Anderson, U. S. Navy. Filed March 16, 1903.

774,943. Controller. Ray P. Jackson, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Jan. 20, 1904.

774,954-955-956. Method of Rotating Field-Magnets of Dynamo-Electric Machines and Method of Rotating the Field-Magnets of Alternating-Current Generators. Charles F. Scott, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 16, 1903, and June 30, 1904.

774,974. Safety Device for Coupling Alternators. Edwin S. Baker and Herbert A. Scott, Piedmont, W.Va. Filed Nov. 12, 1903.

775,005. Electric Time-Switch. Henry K. Gardner, Providence, R. I. Filed Dec. 21, 1903.

775,016. Electric Switch. Isaac G. Waterman, Santa Barbara, Cal. Filed March 9, 1903. Renewed Sept. 7, 1904.

775,017 018-019-020-021-051. Electromagnetic and Electrical Valve-Controlling Mechanism. Isaac G. Waterman, Santa Barbara, Cal. First application filed May 11, 1903. Renewed Nov. 27, 1903.

775,054. Electromagnetic Valve. Isaac G. Waterman, Santa Barbara, Cal. Filed March 9, 1903. Renewed Dec. 24, 1903.

775,056. Electrical-Contact-Controlling Float. Isaac G. Waterman, Santa Barbara, Cal. Filed June 25, 1903. Renewed Sept. 7, 1904.

Telephones and Telephone Apparatus.

774,770. Central-Energy Telephone System. Kempster B. Miller, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Dec. 19, 1900.

774,923. Receiver for Telephones or the Like. Daniel W. Troy, New York City. Filed June 24, 1904.

774,991. Register for Telephones. George S. Nickum Salt Lake City, Utah, assignor of one-half to Harry E. Deardorf, same place. Filed April 4 1904.

775,201. Telephone System. William R. Whitehorne, Bethlehem, Pa. Filed April 27, 1904.

775,226 227-228-229. Telephone Exchange System. Harry G. Webster, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Company, Rochester, N. Y. Filed Feb. 4 and 14, 1903.

775,230. Circuit-Changing Apparatus. Harry G. Webster, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed Dec. 7, 1903.

775,254. Adjustable Support for Telephone-Receivers. George W. Sebastian, Ashland, Ky., assignor of one-half io Jacob Leicht, same place. Filed Jan. 4, 1904.

Miscellaneous.

774,759. Portable High-Frequency Device and Vacuum-Tube Stand. Thomas B. Kinraide, Boston, Mass. Filed June 27, 1904.

774,760. Self-Contained Hand-Electrode. Thomas B. Kinraide, Boston, Mass. Filed July 5, 1904

774,764. System of Electrical Distribution. Paul M. Lincoln, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company, Filed Sept. 30, 1903.

774,813. Electric Signaling System. Samuel M. Young and Fitzhugh Townsend, New York City, assignors to said Young, Filed Aug. 22, 1904.

774,831. Electric Burglar-Alarm System. Clyde Coleman, Chicago, Ill., assignor, by mesne assignments, of two-thirds to the Bankers' Electric Protective Company, same place. Filed Dec. 17, 1896.

774,847. Thermostat. Max J. Levy, New York City, assignor to John D. Gould, same place. Filed Feb. 13, 1904.

774,905. Telegraph-Repeater. William E. Athearn, New York City, assignor to the American Telephone & Telegraph Company. Filed May 13, 1904.

774,922. Apparatus for Receiving Electrical Impulses, Daniel W. Troy, New York City. Filed April 11, 1904.

775,031. Method of Electrically Treating Materials. William S. Franklin, South Bethlehem, Pa., assignor of one-half to Frederick Conlin, same place. Filed Dec. 3, 1900.

775,037. Branch Box for Insulated Electric Wires, Morton Havens, Jr., Albany; N. Y. Filed Nov. 3, 1903.

775,050. Method of Selecting Electrical Impulses. Daniel W. Troy, New York City. Filed April 8, 1904.

775,105. Electric Baker for Surgical Purposes. Walter S. Edmands, Newton, and Charles A. Hoyt, Boston, Mass., assignors, by direct and mesne assignments, to Edward T. Edmands, Newton, Mass., and June Hoyt, Filed Dec. 17, 1902.

775,113. Coherer. Walter W. Massie, Providence, R.I, Filed March 4, 1904.

THE TELEPHONE WORLD.

Kinloch Company to be Competitor of Bell.

The Jerseyville, Ill., city council at a recent special meeting granted a franchise to the Kinloch Long-Distance Telephone Company of Missouri to construct a line through the city and to establish eight toll stations.

The Kinloch Company has already constructed a line from Alton to the Jerseyville city limits, and E. B. Dennison, who is in charge of the work, announced that the line through the city will be built at once.

The Kinloch line will join the Illinois Telephone Company's line north of Jerseyville, and the consolidation will make the Kinloch an active competitor of the Bell Telephone Company in every part of the State.

As soon as the line in Jerseyville is completed, Mr. Dennison states that long-distance lines will be built to Grafton and into Calhoun County, to be united with the Independent lines in that section.

May Mean Telephone War.

It is now stated that the farmers' mutual telephone lines of Hardin County, Ia., will seek to gain an entrance to Iowa Falls in the spring and establish an exchange. Some time ago representatives of these companies approached the city council and asked permission to enter the city and use the streets and alleys for a local exchange, and to give subscribers in other parts of the county toll service into Iowa Falls. This plan has been abandoned, however, and it is understood that the companies will ask for a franchise at the spring election. In the event such a franchise is granted, it will put the new company on an equal footing with the two lines already established there. It is understood that a strong bid for admittance to the city will be made by the new company, in the shape of free county tolls, which will be an innovation in Hardin County.

The Nebraska Telephone Company has filed with the tax commissioner a schedule of its personal property, for the 1905 tax levy. The company's valuation of its personal property, subject to assessment in Omaha, including franchise, is $566,136, an increase of $146,256 over last year, due to improvements and additions to the plant. The value of the franchise is given as $341,136.

A recent organization, known as the Farmers' Mutual Telephone Assocation of Clare, Ia., has been formed by W. S. Lyons, Gust. Baumchen, J. M. Hood, J. J. Condon and Henry Haulwick, of West Jackson, and D. S. Coughoin, G. C. Voigts, P. H. Cain, Bert Schuster, J. McElroy and J. D. Hood, of Deer Creek.

The Franklin Telephone Company will soon begin the extension and improvement of its lines through Franklin County, O. An effort will be made to have a great deal of this work done by spring, in order that solicitors can get to work early among the country people.

The Rockwell, Ia., Telephone Company, capitalized at $25,000, has been organized by E. N. Egge and others

Government to Cut Down Telephone Expenses.

In the general interest of economy, Assistant Secretary Oliver, of the War Department, has notified all the chiefs of bureaus and other officers of the army stationed in Washington, D. C, who have telephones in their homes, that these instruments will no longer be maintained at public expense. The telephone service in the department and its branches in that city is also to be reduced to the lowest possible limit compatible with the interests of the Government.

It is understood that similar action will be taken in other Government departments and that a great saving will be made in the Government's telephone expenses in Washington. Secretary Morton, who has been investigating the subject for several weeks past, will probably submit his report to the President shortly.

There is no immediate prospect of the establishment of an Independent Government telephone service in Washington, the necessity for such a service having been removed, it is said, by satisfactory arrangements with the Chesapeake & Potomac Telephone Company for service.

New Telephone Line for Texas.

A telephone line connecting Sherman and Howe is proposed for the accommodation and convenience of farmers residing between the two places. The Grayson County Telephone Company proposes to build a line connecting the Sherman exchange when as many as 20 subscribers have been pledged, and as a leading farmer and stockman is interesting himself in the project it is thought the line is assured.

Archer, Neb., is to have a telephone system constructed by the Archer Telephone Company, which is capitalized at $50,000. The directors are A. J. Harshberger, J. B. Templin, William Johnston, H. G. Mithofer and F. F. Wagner.

It is stated on what appears to be good authority that the Chicago Telephone Company will issue more new stock soon after the first of the year.

The Delmarvia Telephone Company has begun the work of laying telephone conduits in the streets of Wilmington, Del.

Articles of merger and consolidation have been filed by the Winchester Telephone Company of Virginia and the Cumberland Valley Telephone Company of Baltimore, Md.

The report that the Hartwick, N. Y., Independent Telephone Company had sold out to the Bell Company, is said by the officials of the company to be untrue.

Articles incorporating the Pullman Telephone Company of Elkhart, Ind., and Edwardsburg, Mich., capitalized at $10,000, have been filed.

The lately organized Pride Telephone Company will construct a line to Good Thunder, Minn.

Trolley Line to Inaugurate Telephone System.

It is proposed to erect a telephone system along the Philadelphia & Easton, Pa., trolley line at once. The wire has arrived and will be placed on the poles as soon as possible. This will facilitate the operation of the road. At present there is no means of communication between points in case of a mishap of any kind. It is thought the sub-power house at Danboro will be placed in service within two or three weeks. This will add largely to the power along the lower end of the line, and will facilitate the operation of the cars on schedule time.

The Hot Springs & Point Cedar Telephone Company of Hot Springs, Ark., has been chartered by that State. The capital stock is $2,000. The officers are L. B. Estes, president; C. H. Easley, vice-president; H. Hardy, secretary, and William Lambert, treasurer. It is proposed to build a line from Hot Springs to Friendship, in Hot Springs County, 30 miles, with a branch from Caney Church to Point Cedar, 20 miles.

Among the applications for franchises is the Carmel Telephone Company to construct and operate a system in Carmel, W. Va.; the Union Development Company, to operate a telephone system in Whitefield County, Ga.; the Interstate Independent Telephone & Telegraph Company, of Peoria, Ill., to operate in Averyville, Ill., and the Central Maine Telephone Company has asked to be admitted to the village of Skowhegan.

The Independence, Ore., Telephone Company will build a line to Monmouth, and will connect with the Louisville, Airlie, Fall City and Dallas lines. A central office will be installed in Independence. Dr. O. D. Butler, W. A. Messner and J. R. Craven are interested in the concern.

The American Construction & Trading Company has turned over to the Home Telephone Company, of Cohoes, and Waterford, N. Y., the entire Cohoes system. A number of residents of Cohoes have become financially interested in the new venture.

The L. M. Ericsson Telephone Manufacturing Company of Tonawanda, N. Y., which was recently incorporated, will soon establish a big plant near Buffalo, the site for its factory having been purchased.

The Kineon Telephone Company has established communication between Cincinnati, O., and Butler, Ky. The connection with Butler by the Kineon people means that they can traverse the whole South with their lines.

News from Jonesville, La., states that the Natchez and Jonesville long-distance telephone line is now open and ready for business.

A franchise has been granted a telephone company in Estherville, Ia., and will enter into competition with the Western Electric Company.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Arcata, Cal.—A. H. Cheney, of the Madison Mercantile Company, has purchased the Arcata electric light plant. The purchase price is said to be $20,500.

Arenzville, Ill.—W. H. Arenz plans to install a new electric light plant in the opera house.

Clifton Springs, N. Y.—The contract for the building of the electric light plant here has been let to R. Murphy and A. Barry.

Creston, Ia.—The citizens here will soon vote on the matter of granting a franchise for the establishment of another electric and gas company. N. M. Harrison, of Osceola, and Mr. Miller, of Red Oak, are interested.

Delavan, Ill.—The electric light plant was recently burned, and the city is without light.

Fort Pierce, Fla.—Joseph Jefferson, A. R. Blanjou and C. C. Chillingsworth are organizing a company to put in an ice and electric light plant here.

Greensboro, Ga.—The election here this month, to decide the question of issuing bonds for the purpose of erecting an electric light plant, went unanimously for bonds. The bonds will be placed on the market at once, and the electric light system will probably be installed at an early date.

Greenville, Tex.—A special election will be held December 7 for the citizens to vote upon the question of selling the city electric light plant.

Louisa, Ky.—Reports state that the Louisa Water Company, of which W. B. Cox is manager, will install an electric light plant with a capacity of 300 lights.

Mackinaw, Ill.—Fire recently destroyed the electric light plant here, causing a loss of $10,000.

Mansfield, Ill.—The Mansfield Electric Company has been incorporated with a capital of $10,000, to ereet and operate light and power plants. E. F. Saylor and R. E. Howe are interested.

McHenry, Ill.—The McHenry Electric Light, Heat & Power Company has been organized with D. C. Doe, president, and W. D. V. Ball, vice president.

Newbury, Vt.—Several meetings have been held relative to installing an elctric light plant, and the matter of incorporation for this purpose is being considered.

Penbrook, Pa.—The Central Pennsylvania Traction Company is considering plans for furnishing electric light to residences along its line between here and Linglestown.

Richmond, Va.—The city is consideriug the proposition of constructing and operating an electric plant on its own account.

San Jose, Ill.—An electric light plant is soon to be installed here.

Scottsville, N. Y.—The Scottsville Electric Light & Gas Company has been formed with a capital of $20,000. Merton E. Lewis and Henry R. Brewster, of Rochester, and others, are interested in the new enterprise.

Thomasville, Ga.—An election was held here recently to decide the question of issuing bonds to procure an electric plant for the city and for establishing a sewerage system. It resulted in a victory for bonds. Bonds to the amount of $60,000 will be floated at once by the city.

Waverly, Ia.—At a recent adjourned meeting of the city council the Healy electric light plant was purchased. The price paid was $13,500. By this purchase this city gets immediate control of the existing plant.

Wellington, Kan.—Extensions of the water and electric lighting service has been commenced.

Wetumpka, Ala.—The city council at a recent meeting decided to call an election for December 12, to vote on the issuance of bonds for the purpose of installing waterworks and electric lights.

STREET RAILWAYS.

Boston, Mass.—The receivers of the Bristol County Street Railway will sell the property of the company at public auction on December 17, at Attleboro. The receivers of the Middleboro, Wareham & Buzzard's Bay Street Railway will sell the property of the company at public auction on December 7, at Middleboro.

Cairo, Ill.—J. J. Freudlich, of Paducah, is at the head of the new electric railroad to run from Paducah to East Cairo.

Clayton, Mo.—The St. Louis County Court here has granted the petition of the St. Louis & Valley Park Railway Company for a franchise to construct an electric railroad from St. Louis to Valley Park.

Cleveland, O.—Plans are about complete for the building of an electric railroad from here to Meadville, Pa., by the Cleveland, Geneva & Meadville Railway Company.

Harrodsburg, Ky.—The people here are greatly elated over the prospects of an electric railway system connecting this city, Danville, Junction City, Stanford, Lancaster and Perryville. It is said that the plans of Mr. Snyder, who has been granted a franchise to build an electric line to Junction City, contemplates the building of such a line, and Harrodsburg will at once take steps to have the line built and will do her part in the matter.

Langhorne, Pa.—Directors of the Feasterville and Richboro turnpike have sold five miles of the road, from the city line to Richboro, to Langhorne parties for $5,000. It will be used for the proposed trolley line from this town through Trevose and Feasterville to Somerton.

Middletown, Pa.—Surveys are now being made for a new trolley line between here and Elizabethtown.

Monongahela, Pa.—G. O'Leary, representing the Monongahela-Ellsworth & Washington Electric Railway Company has notified R. McNeal that he would accept the commissioners' proposition, and take a franchise over the old National route. The line will extend from this city, and finally be connected with the proposed extension of the Wheeling & Elm Grove line to Washington.

New York City.—The New York, New Haven & Hartford Railroad Company has begun work on the proposed new six track electric rapid transit system from New Rochelle to the Harlem River. The company intends to spend $15,000,000 on improvements.

Oconomowoc, Wis.—The surveyors have been over the right-of-way for the extension of the electric road from the Beach to this place via Delafield.

Reading, Pa.—Preparations are being made to begin building the trolley road between this city and Pottstown.

Saranac, Mich.—Frank Westcott, of Vernon, says a group of four electric roads, in which he is interested, will surely be built. Material is now being drawn on the ground for a power house here.

Scranton, Pa.—W. H Truesdale, of the Delaware, Lackawanna & Western Railroad, said last week that the Lackawanna had for some time been making plans looking to the substitution of electricity for steam as a motive power on the suburban lines of the road. These plans, he stated, are now so far advanced that the work of installation will begin as soon as a number of grade crossings along the suburban divisions of the Lackawanna have been done away with.

Siloam Springs, Ark.—The Siloam Springs Electric Railroad, Power & Improvement Company has been organized with a capital of $500,000.

Tampa, Fla.—Col. C. Denman, president of the Peninsular Telephone Company, has been inspecting ground for a proposed electric railway service between here and Plant City.

POWER PLANTS.

Bangor, Me.—The Sanford Mills Company has purchased from B. C. Jordan three mill privileges on Mousam River, and will build a large stone dam just above the town line. This dam will be 40 feet high from the river bed, and 250 feet long. From the dam an iron flume 6 feet in diameter will extend to still water below, giving 80 foot head for the operation of an electric power plant.

Toronto, Ont.—It is expected that by next spring the water power now being developed on the Wahnapitai River, near Sudbury, will be completed and the company will be delivering power. The town of Sudbury will take electric power to run its light plant and waterworks, and it is probable that the Mond Nickel Company will also take power for its mines and reduction works.

BIDS WANTED.

Washington D. C.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until November 29 for furnishing the League Island and Washington Navy Yards with a quantity of incandescent lamps, panel boards, telephone sets, wattmeters, electric carbons, wire, conduit and fittings, and miscellaneous electrical supplies. Blank proposals will be furnished upon application to the Navy pay offices at Philadelphia and Baltimore, or to the Bureau. On December 13 the Bureau will open bids for furnishing the Mare Island and Puget Sound Navy Yards with a quantity of recording wattmeters, voltmeters, conduit, engine indicators, copper and magnet wire, single and twin lightning wire, fuse wire, electric clusters, insulating and Grimshaw tape carbon, glass tube fuses, miscellaneous electric supplies and a telephone system. Intending bidders can obtain blank proposals upon application to the Navy pay offices in San Francisco, Cal., and Seattle Wash., or to the Bureau.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, $14\frac{3}{4}$@15c.; Lake $14\frac{7}{8}$@$15\frac{3}{8}$c.; casting, $14\frac{1}{2}$@$14\frac{3}{4}$c.

The Philadelphia Electric Company has declared the usual semi-annual dividend of $2\frac{1}{2}$ per cent., payable December 15.

Directors of the City Railway Company of Chicago will meet November 30 to declare the regular quarterly dividend.

There is a strong belief that the Metropolitan West Side "L" of Chicago will declare a dividend on the preferred stock in February.

The Magnetic Control Company of New York City has been incorporated with $1,000,000 capital to manufacture electrical and magnetic machinery.

All the big railroads in Rochester, N.Y., are considering an electric belt line, about 100 miles, to connect the principal towns of the Genesee Valley.

The Colorado Telephone Company, one of the Bell companies, will increase its stock from $5,000,000 to $10,000,000, making additional issues as may be required.

The Philadelphia Rapid Transit assessment of $5 a share is made payable January 20. The $5 call will bring $3,000,000 into the treasury, there being 600,000 shares of stock.

Chicago Edison Company directors have voted to issue 20 per cent. more capital stock to stockholders at par, payable in four installments, February 1, 1905, May 1, August 1 and November 1.

One of the directors of the American District Telegraph Company denies the rumor that control of the company has been purchased by the American District Company of New Jersey.

The National Carbon Company has declared an initial dividend of $1\frac{1}{2}$ per cent. on the common stock, payable in January. This, however, does not place the stock on any fixed dividend basis.

Judge Wallace, in the U. S. Circuit Court, New York, has handed down an opinion that any one who buys stock in a corporation on the strength of false statements by its management may recover his money from the corporation.

Representatives of the Eastern interests in the Chicago Union Traction Company say that they are in no way interested in the Chicago Subway Company, incorporated at Trenton, N. J., on Monday with a capital of $50,000,000. The incorporators were "dummies" from the office of the Corporation Trust Company, 15 Exchange place, Jersey City.

At a special meeting of stockholders of the Edison Electric Illuminating Company of Boston, Friday, the capital stock was increased from $10,449,100 to $11,449,100. The directors now offer stockholders of record of November 18, 10,450 shares at $200 per share at the rate of one new for every ten old shares held. The right to subscribe expires December 15 and all subscriptions and assignments of rights must be sent to the Old Colony Trust Company on or before that date.

Opposition to the Seattle Electric Company, owned by a syndicate of Boston capitalists, has assumed a formidable aspect, through the consolidation of the Snoqualmie Falls & White River Power Company, the Seattle Cataract Company and the Tacoma Cataract Company into the Seattle-Tacoma Power Company with a capitalization of $3,500,000. The new company will compete with the Boston company for the lighting and power business of western Washington.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Nov. 21
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	$167\frac{1}{4}$
Metropolitan Street Railway	$124\frac{1}{4}$
Metropolitan Securities	$82\frac{1}{4}$
Ninth Avenue	197
Third Avenue	131
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	$68\frac{3}{8}$
Public Service Corporation (New Jersey)	107
Philadelphia.	
Consolidated Traction of New Jersey	78
Philadelphia Traction	98
Union Traction	59
Boston.	
Boston Elevated	$154\frac{1}{8}$
Massachusetts Electric Companies, com	$16\frac{1}{4}$
do. do. do. pref.	$59\frac{3}{4}$
West End Street, com	92
do. do. do. pref.	112
Chicago.	
City Railway	185
North Chicago	79
Union Traction, com	$14\frac{7}{8}$
do. do. pref.	$45\frac{1}{4}$
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	$20\frac{3}{4}$
do. pref.	70
Electric Boat, com	43
do. do. pref.	71
Electric Lead Reduction	$\frac{1}{8}$
Electric Vehicle, com	16
do. do. pref.	24
Westinghouse, com	179
do. pref.	195
General Electric	$189\frac{5}{8}$
Boston.	
Edison Electric Illuminating	241
General Electric	$189\frac{3}{4}$
Westinghouse Electric & Mfg., com	86
do. do. do. pref.	95
Chicago.	
Chicago Edison	170
National Carbon, com	43
do. do. pref.	110
Philadelphia.	
Electric Company of America	$10\frac{7}{8}$
Electric Storage Battery, com	83
do. do. do. pref.	83
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	145
Western Telephone Company	19
New England Telephone Company	134
New York.	
American Telegraph & Cable Company	$93\frac{1}{8}$
Commercial Cable Company	210
Mexican Telephone Company	$2\frac{1}{8}$
New York & New Jersey Telephone Company	$158\frac{1}{4}$
Postal Telegraph Cable Company	..
Western Union Telegraph Company	$92\frac{1}{4}$
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	48
Consolidated Car Heating	64
Standard Underground Cable	200

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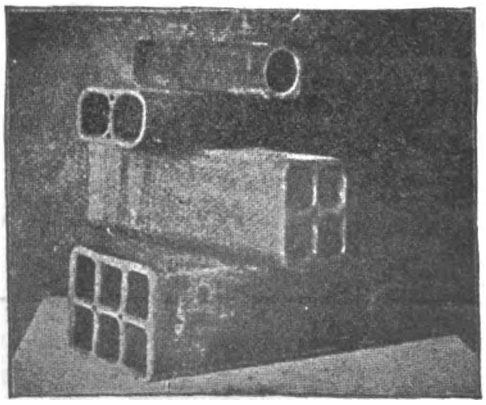

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CONTENTS.

EDITORIAL NOTES.

Daylight Stops Wireless Telegraphic Waves.

There is abundance of evidence accumulated to show that the new era upon which science is entering owes its existence to a fuller and better knowledge of the meaning of electric waves. The wave theory is about to have its way, and in its wide embrace may be found the territory once occupied by chemistry, optics, heat, spectrum analysis, electricity and magnetism. These great fields of theoretical and applied science have yielded rich returns to those patient investigators whose combined influence has been the means of bringing the world to a recognition of the play and by-play of enormous forces, which, operating upon matter in an organized and unorganized state, has built up, as it were, the universe around us. Extraordinary effects have been recently observed. Transmutations and transformations are not only familiar forms of energy but of matter. The announcement of Marconi, as referred to by Fleming in his article on Wireless Telegraphy, that daylight prevented him from reaching more than 700 miles from Poldhu station with his waves, while at night the darkness enabled him to send his impulses 2,100 miles, opens up a line of inquiry that as yet has remained without adequate explanation.

What are the influences of the waves of daylight upon the longer waves emitted by a wireless telegraphic transmitter? Were other influences operating during the daytime which cut down the effectiveness of the waves from 2,100 to 700 miles; or can this difference only be attributed to the daylight?

These are interesting questions and they bring us face to face with startling possibilities. One of these possibilities is the existence in the sunlight of a perfect storm of electrons. These, perhaps, are the antagonistic influences which destroy the Hertzian waves. Shot out from the sun and traveling 92,000,000 miles with terrific velocity, they eventually make their presence felt by neutralizing the waves. At night the waves are shielded by the earth, the sunlight falling on the other side with its accompaniment of electrons. This, at present, is the most advanced and most rational explanation. But the question of how this reaction takes place, and of what these charged solar corpuscles consist, may remain unanswered for many days. It is in this respect that science becomes powerless for want of exact knowledge and for that reason such hypotheses as we now have must be changed in the course of time to conform to the facts of every new discovery.

* * *

The Reduced Weight of Motors in Electric Cars.

One of the distinct advantages of design has been the ability of the electrical engineer to reduce the weight of street car motors. An arc lamp of fifteen years ago bears the same relation in weight and construction to those now in use as the first car motors of that period do to those of the present hour. Not only have they been constructed to suit the severe requirements of city service, but their efficiency and weight have undergone advantageous changes that yield excellent returns in a commercial sense.

It must be understood that the motor of a car is a heavy weight that pays no fare. It wears out and uses power to carry itself. It is an expense in every manner, and in some instances street railway companies claim that repairs eat up

their profits. A light and powerful motor has thus far solved the problem, and the nickels saved by reduced weight are saved again in the repair bill and coal consumption at the power station. A cut in weight of 500 pounds per car would mean in the case of 1,000 cars 500,000 pounds less per day to be carried around. This would mean the equivalent of 3,000 passengers, or an increase in profit of this amount for exactly the same output of power, otherwise an expenditure of just that much less power with empty cars.

* * *

Lowering the Costs of Electrical Production.

The recent presidential address of Mr. Alexander Siemens to the London Institution of Electrical Engineers did not deal particularly with any one branch of electrical science or engineering, but it was devoted to certain questions of the hour which have an important bearing upon pretty well all branches. He mentioned causes which influence the growth of industries, and thereby the rise of institutions, as an illustration of the interdependence of all factors of modern civilization, and expressed the opinion that the true foundation of this civilization was the lowering of the cost of production. The process of lowering the cost of production implies the employment of all the knowledge we can acquire, and of all the training that the best schools can give us, and it results in greater ease of acquiring the necessaries for keeping alive. Mr. Siemens stated that this general principle had manifested itself as much in the electrical industry as elsewhere, and that further progress appeared to be dependent on further lowering of the cost of its products. Every industry is dependent upon three principal factors—(a) the capital which provides the works and the raw material; (b) the workman who converts the raw material into the finished product; (c) the management, and the president proceeded with a detailed examination of the way in which each of these three factors could contribute to the lowering of the cost of production. It goes without saying almost, that any measure which is intended to unduly favor any one of these three factors would inevitably increase the cost of a production beyond what it ought to be, thereby restricting the sale and damaging the interests of all three parties. The necessity for careful planning and equipment of works, the cost of raw materials, the profit on capital invested, and the discretion needed in laying out capital expenditure upon patents which a short lapse of time might render out-of-date, were all in turn touched upon. Many of Mr. Siemens' comments related to the imperative necessity for the most liberal adoption of labor-saving tools, and to the attitude of the worker toward them. Mr. Siemens stated that there seemed to be considerable difficulty in convincing workmen in British manufactories that "increase of output" is of advantage to them. Restriction of output is bound to have exactly the opposite effect to what its advocates expect from it.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

New York's subway finished its first month at 7 o'clock last Saturday night. Up to that time about 6,000,000 passengers have been carried by the road.

Mr. Thomas A. Edison, in a message to a daily newspaper, says: "I realize that I am no longer young, but I shall yet give to the world the greatest of my inventions."

A school for the study of wireless telegraphy has been instituted in the navy yard in Brooklyn, N. Y., and at present the class comprises 25 young sailors. As soon as they have become proficient they will be assigned as operators to the various stations and war vessels.

The next meeting of the Electrical Section of the Western Society of Engineers will be held December 16 at the Society's rooms in the Monadnock Building, Chicago. Prof. Henry Crew, of the Northwestern University, will lecture on "Modern Theories of Electric Arc and Spark."

A recent issue of "The Indian, Electrical, Mechanical and Textile News" describes the electric generating plant of Bombay. The station contains one 300 kw., 5,500 volt three-phase steam alternator and one 500 kw., 5,500 volt three-phase turbo-alternator, which are excited by two 100 kw. directly coupled dynamos. The frequency is 50 cycles per second. The 300 kw. set is coupled to a Brush engine and runs at 333 revolutions per minute when supplied with steam at 150 pounds, superheated by 150 deg. F. It is to be capable of dealing for short times with an overload of from 10 to 15 per cent., and to work either condensing or non-condensing. The cylinders are 16½ and 23 inches diameter by 10½ inch stroke. It is specified that the speed is to keep within 2½ per cent. up or down, and all bearings have forced lubrication, the oil being cooled by passing through a coil placed in running water. The 300 kw. alternator has a stationary armature and revolving multipolar field, and is to be capable of running in parallel with the turbo set. Carbon brushes running on phosphor bronze collecting rings are employed. The turbo set runs at 3,000 revolutions per minute, and is of the Brush-Parsons parallel flow multifold expansion type, using steam through the full range from boiler pressure to the vacuum. There is a by-pass to allow of high-pressure steam being admitted to the low-pressure portion for large overloads. The lubrication is by two motor-driven three-throw oil pumps, each capable of supplying oil to all the bearings of three such sets.

Mr. E. W. Lloyd of the Chicago Edison Company has accepted an appointment from President Davis to prepare a report on purchased electric power in factories, to be presented at the 28th convention of the National Electric Light Association. Mr. Lloyd has already begun work on this report and, as it is a subject of the greatest importance to central stations—as the power load is rapidly becoming the important part of the business in many localities—it is to be hoped that managers will take pains to fill in as fully as possible the data blanks being sent out by Mr. Lloyd.

Among the more notable recent German inventions in the field of applied science is an electric resistance material for heating purposes, to which the name of "kryptol" has been given. The exact method of its preparation is not disclosed by the patent specification, but it is a mixture of graphite, carborundum, and clay, and is made in four grades of coarseness. The property of kryptol upon which its efficiency depends is the fact that it offers to an electric current the requisite degree of resistance to generate a high degree of heat without destruction to its own substance. In its application to a cooking stove, kryptol is sprinkled over an earthenware plate, and upon the current being switched on it readily generates sufficient heat to boil a kettle of water in three or four minutes.

The next annual meeting of the National Electric Light Association will be held in Denver, Col., in June, 1905. The business meetings will be held in Denver, and the Pike's Peak country will be made the pleasure ground.

THE CARE, TESTING AND ADJUSTMENT OF INTEGRATING WATTMETERS.*

BY K. L. AITKEN.

The great number of electric light companies now in operation has made the position occupied by the integrating wattmeter a most important one. Its chief requirements are initial and continued accuracy under wide variation of load and an almost negligible depreciation. The latter interests the power plant operator only, but the former affects alike both the operator and the consumer. In a steam driven plant, the difference between the readings of the station meters and the aggregate readings of the service meters has to be carefully watched, as this indicates the condition and efficiency of the transmission system. Also, the operator desires his meters to be acturate so that he will receive payment for the full amount of power distributed, and on the other hand, the consumer demands accuracy as an insurance against overcharging.

Speaking generally, the attention required by wattmeters is many times greater than they receive—rough handling and careless installation are usually responsible for the numerous troubles the central station manager encounters in this department. If he could see his men drop the instruments on the floor as if they were mere scrap iron, he would better understand the chief source of these troubles. On many occasions when the accuracy of some particular meter has been questioned, the writer has found the instrument set up as much as 10 degrees out of level.

The wattmeter is, at best, but a delicate piece of apparatus, and should always be considered as such. The jewel can be lowered, and the moving element secured in various ways, but nevertheless, even when this has been done, the meter should be handled just as carefully as if the weight of the disk were resting on the jewel. This attention can never do any harm, and, no doubt, in many cases is responsible for much good.

Outside rough usage, the accuracy of a meter can be affected by a number of causes, all of which, with the exception of friction, may be charged to poor design or poor manufacture. The question of bearing friction is one requiring very careful consideration, for the lack of permanency of calibration can usually be accounted for by the varying of this factor. Friction cannot be eliminated entirely, nor can its increase in service be prevented, but if the design of the meter in the first place makes of this item an almost infinitesimal quantity, then it stands to reason that the increase due to wear will be unimportant. Allow that friction can be made an almost constant quantity, and then the proper compensation comes as a comparatively simple matter.

When the disk of a meter is in motion, the friction is not materially affected by vibration; that is to say, the friction will remain the same whether the meter be mounted on a solid masonry pedestal, or on a thin wooden partition close to running machinery. But the static friction, or friction when the disk is not moving, will be many times greater when the meter is mounted on the solid support. Therefore, the compensating adjustment which will make a meter accurate at low load in one location, will make it creep with no load if subjected to even slight vibration. Modern meters have, however, a non-creeping device which overcomes this fault to a great extent, but adjustment has often to be made to suit the conditions under which the meter operates in service.

So far the question of accuracy has been considered from the standpoint of those locally interested only; the Government regulations in connection with this subject will now be taken up. The Electric Light Inspection Act, of 1894, states that if the consumer so desired, such electricity as used by him shall be ascertained by a suitable meter, duly tested and certified correct by an inspector, and also that no meter shall so be used which has not been tested and verified. The requirements for accuracy are such that when any meter is in operation it must not indicate more than 3 per cent. above or 3 per cent. below the reading by the inspector's standard. If an inspector finds a faulty meter, he can do nothing but condemn same—he is not allowed to either repair or adjust the instrument. All electric light companies are required to provide, free of charge, a suitable place for the testing of all meters used on their circuits, together with such electricity, wiring, and other facilities needed for said tests. A lamp-bank is by far the most satisfactory method of providing a load. Grids can be used, but draughts of air materially affect their resistance, and the current varies accordingly. The incandescent lamp reaches its final temperature very quickly, and not being influenced by external conditions, is really the most reliable means of securing a constant current consumption. Keyless sockets should be used, and the entire bank controlled by switches within easy reach of the operator; the bank itself should be located well up the wall, or even on the ceiling, so that the light and heat will not interfere with the work of testing. In Fig. 1 is shown a lamp-bank of about 11 kilowatts capacity, the switching arrangement, permitting use on either two or three wire meters, and combining latitude of control with means for fine adjustments. Many modifications of this bank can be made, but it is essential to retain the features mentioned.

In the limited space available for this article, it is not possible to show the numerous connection diagrams for meters of various manufacture. Those who are directly interested in the work, can, upon application, obtain from the makers diagrams and special instructions relating to any instrument.

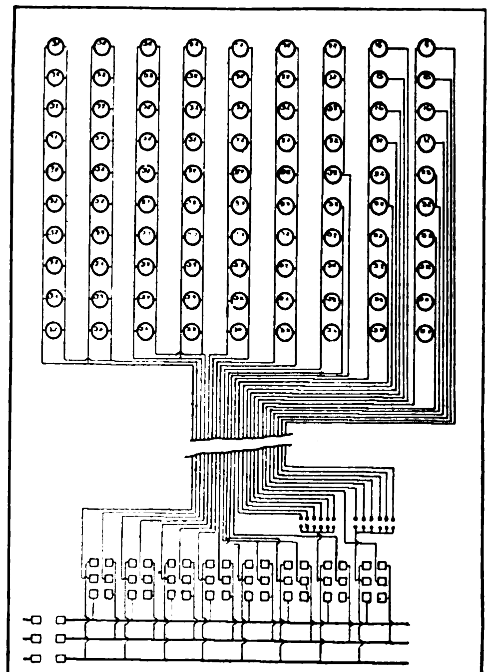


Fig. 1

A large number of pamphlets have been issued on the subject and the manufacturers stand ready to supply these upon request. The following information is of a general nature, and is given as such only.

The first consideration is to provide a non-vibrating support for the meter and test instruments, and to see, after a general inspection has been made, that such meters requiring leveling are really level. In current meters, an ammeter is the only test instrument needed, in addition to a stop-watch, but for the integrating wattmeter, an ammeter, a voltmeter, or an indicating wattmater, or a combination of the three, is required. In using these instruments, great care must be taken in all readings; the current and voltage must be kept constant, and in the event of a variation, same should be

* From the "Canadian Electrical News."

carefully noted, and the final readings averaged.

By far the easiest method of making tests, and the one requiring the smallest expenditure for instruments, is by use of a "standard" integrating wattmeter. With this the time element, and the great need for constant wattage, are eliminated and therefore the chance of error is reduced. In most cases, a synchronizing of the disks is the only needed reading.

The first step after setting the meter is to give it a short run with a medium load, noting at this time that the direction of rotation is correct. Then, with all load removed, the compensating device should be moved up till the disk revolves freely, and then moved carefully back to the point where the meter just stops. This will make the torque of the compensator almost sufficient to overcome the kinetic friction.

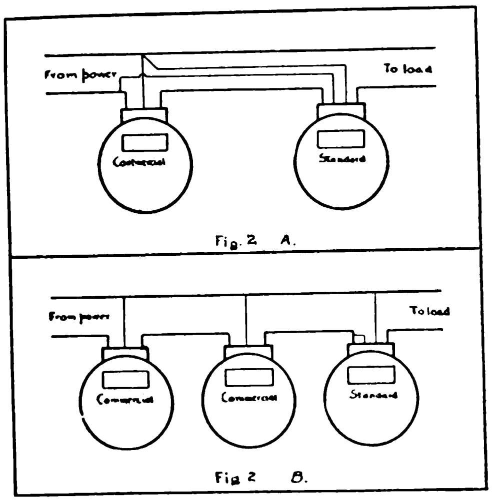


Fig. 2 A.

Fig 2 B.

Then, with full load, the permanent magnets should be adjusted so that the recording is at the proper rate. In some meters the poles of the permanents are entirely within the circumference of the disk, while with others the poles are only partly inside the edge. Therefore, in the former cases, a movement outward will slow the meter for a given current, and in the others, an inward movement produces the same effect. After the reading is correct for full load, other loads should be tried, making a point of a test at about 1 or 2 per cent. of the rated capacity. If a check within the Government limits is not obtained, the entire operation should be repeated, and no doubt the trouble will be found in the original adjustment of the compensator.

In checking meters, one mistake is very frequently made, and that is the attempt to run two or more instruments with the standard at the same time. This cannot be done where separate shunt leads are not provided, for while the meter nearest the load will register correctly, the one next it will show, in addition to the load, the shunt current of the first meter. In the standard, both connections of the shunt coil are brought out separate from the current leads, but in commercial instruments this is seldom the case. Fig. 2A shows the proper way to connect one meter with the standard, and Fig. 2B indicates the error just mentioned.

It is the practice of some manufacturers to send out their meters calibrated and sealed, and to assume no responsibility for accuracy if the seals be broken. This is a wise and commendable policy, for the insides of a meter are to the average electrician as the wheels of a watch to a small boy—the taking apart is interesting without doubt, but when reassemblage is attempted, there is usually enough spare parts left over to equip a small repair department. It is therefore a safe and rational procedure to return to the manufacturer, with seals intact, any meter which is inaccurate, and this practice should apply with equal force in many cases where unsealed instruments are used.

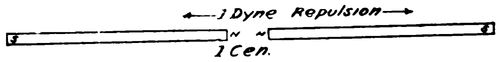
ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

MAGNETISM.

A Unit Pole.—The exact measurement of magnetism is carried out by basing all calculations upon certain units, which are derived by reference to the centimeter, gramme and second system. The unit pole may be regarded as the foundation of such a system and is defined as follows: A unit pole repels a similar and equal pole at a distance of one centimeter with the force of one dyne.

It can be seen that the measurement of magnetism is based upon an idea easily

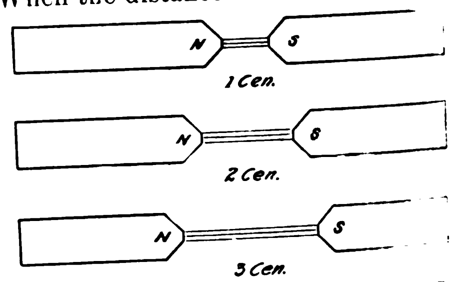


Unit Poles Acting Over Unit Distance with Unit Force.

comprehensible. A magnet repels another magnet with a given degree of force and is thus named in accordance with the requirements of the definition.

Were the magnetic poles so powerful that the repulsion could be measured in pounds, then the idea would be capable of demonstration with exactitude on a large scale. But this is not the case, and the force developed is very small. It is therefore best represented practically by two long steel needles, whose north and south poles respectively are thereby widely separated, and for this reason it might be said that the only effect perceptible when the two north poles are brought within one centimeter of each other is that of repulsion. It becomes necessary therefore, in order to experiment along the lines of this problem successfully, to select needles whose poles will develop only the required amount of repulsion at a distance of one centimeter as prescribed. This is not a difficulty in a practical sense, but it would be, at its best, only an approximation to the theoretical truth, for it is easy to see that the conditions imposed are ideal, namely, only two *north poles* placed at a unit distance from each other, and across this distance developing unit force.

Actions in the Ether.—The law governing magnetism is the same as that which holds in the case of gravitation; and if there were such a thing as attraction existing, it would be true also for light, which varies inversely as the square of the distance. By this is meant that magnetism in common with gravitation, light and heat varies, as it is called, according to the law of inverse squares. When the distance between two magnetic



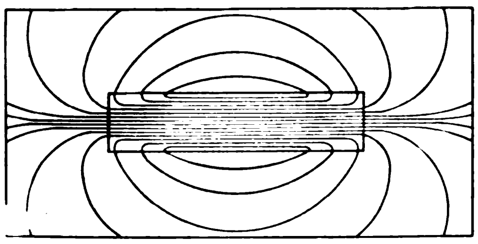
Magnetic Attraction One, One-Quarter and One-Ninth.

poles is *doubled* the intensity of the magnetic field is diminished to *one-quarter*; if tripled the field is reduced to one-ninth, etc. And this is also true of the attraction between magnetic poles of opposite polarity. It seems, in total, as though all actions taking place through the ether, such as magnetism, light, heat, gravitation, etc., act in accordance with the general law that the effect is inversely proportional to the square of the distance. This fact is noteworthy in more senses than one, because the trend of modern thought lies in the direction of hunting for evidence as to the relationship between force and matter in the ether. The power which moves a heavy trolley car is communicated to the axle through an apparently empty space, existing between the magnetic poles and the rotating armature, as it is called. This space is at least an eighth and often a quarter of an inch in depth. Yet through it and in it is developed the enormous force which propels a surface car, or a train of electric cars or huge electric locomotives, such as those recently completed for one of the greatest steam roads in the United States.

And if the question should be asked

"where does the power go to in a dynamo?"—it might be said that as the dynamo is called upon to produce more and more electricity for outside consumption, in like proportion it becomes more and more difficult to overcome the force developed in this visually empty space between the magnetic poles and the armature. The engine, therefore, gives up its mechanical force in overcoming this drag and it thus becomes evident that the ether in the space mentioned plays a very practical part in the consideration of either the dynamo or the motor.

What is a line of force.—By placing a sheet of glass or paper upon a magnet and gently sprinkling iron filings, images of the magnetic lines of force are formed which may be retained if the paper has been paraffined and then subjected to heat after sifting the filings. These were called by Michael Faraday physical lines



Physical Lines of Force of a Bar Magnet.

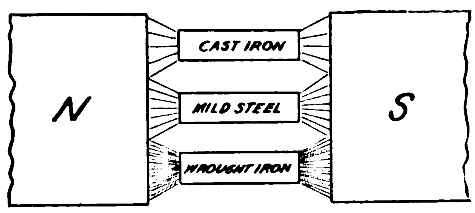
of force and actually represent the distribution of the magnetic field.

The argument laid down in favor of choosing magnetic lines which can be calculated is this—that the physical lines of force as they appear cannot be readily ascertained. It is impossible to count them, and for that reason a line of force must be arrived at whose value is unchangeable and therefore reliable. But this line of force must at the same time represent the magnetic force referred to as physical, only differing from it in this respect, that the physical line of force is of arbitrary value while the scientific or theoretical lines of force are absolute.

Having defined a unit magnetic pole, it is now essential to come to some conclusion regarding the number of lines of force it produces. To accomplish this a certain picture is presented representing a sphere with a unit pole at its center. The size of the sphere is clearly defined as of one centimeter radius, and if the unit pole is at its center then it can easily be realized that this pole is radiating its magnetism equally in all directions. If the amount of magnetism passing through one square centimeter on the surface of this sphere is considered, it will be found to be exactly equal to that passing through any other square centimeter. This amount of magnetism is called *a line of force* and represents the exact value of the line of force used in the design and calculation of magnets, dynamos and motors.

The surface of any sphere is equal to four times the area of its greatest circle, therefore to obtain the area of the surface of this sphere of one centimeter radius and thereby obtain square centimeters of surface its great circle $\pi \times r^2$ is multiplied by 4. But as $r = 1$ the square centimeters or surface of the sphere are equal to 4π or about 12.57, which equals the number of lines of force a unit pole produces.

The Permeability of Iron or Steel.—Lines of force enter iron or steel and produce within these metals a polarized con-



Showing How Metals Carry More or Less Lines of Force.

dition of their molecules. If the magnetic field between the poles of a powerful magnet is taken as a basis for experiments then the following facts will be noted if equal sized bars of cast iron, steel and wrought iron are tested:

Experiment with cast iron—pull very strong.

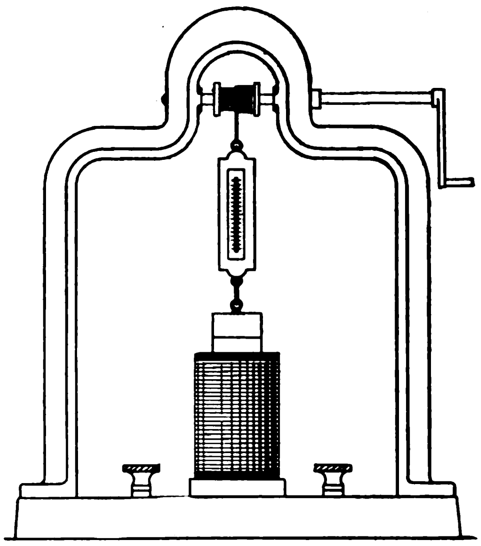
Experiment with mild steel—pull stronger.

Experiment with wrought iron—pull greatest of all.

The meaning of this experiment is as follows: With the cast iron a certain number of lines of force are developed which do not yield the same attractive force as either the mild steel or the wrought iron. In other words, the number of lines of force the cast iron develops are less than those of either the steel or wrought iron.

If the number of lines of force are any measure of the pull of a magnet, then the cast iron, mild steel and wrought iron differ from each other as far as magnetism is concerned only in this respect. If a bar of each of these metals of one square inch cross section is exposed to the influence of a powerful magnetizing force, then if some means would be provided by which the magnetism or number of lines of force excited in each of these bars respectively could be measured, some comparison could be made between them for the purpose of discovering in what respect and to what extent they differ.

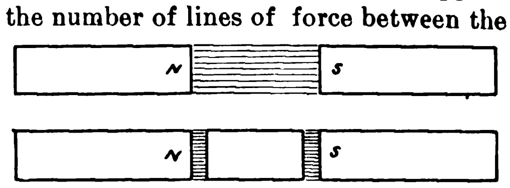
By employing an electric current in connection with a large electro magnet, sufficient magnetism can be obtained to make a test of each of these bars. A button of wrought iron attached to a spring balance with a little reel to gradu-



Machine for Registering the Pull of a Bar of Iron Inside a Coil.

ally develop the pull is all that is required. The wrought iron, according to such an experiment, will show the greatest pull in pounds, then comes the mild steel and finally the cast iron. It is possible to test any sample of iron or steel by this means, and if the device is well constructed considerable accuracy results. The three metals referred to are greatly used in the construction of electrical machinery.

It is evident that if magnetizable metals behave in this manner it is necessary to use some distinguishing phrase to mark this difference. The term "permeability" is employed for this purpose and the metals are referred to by saying "the permeability of wrought iron is greater than steel," or "the permeability of steel is greater than cast iron," etc. In other words, to reduce this data to exactness, for future use, and for the purpose of having a definite view of the subject, the permeability of a piece of iron or steel is the ratio between the strength of magnetic field with iron in and iron out. To illustrate this fact a little further, suppose the number of lines of force between the



Lines of Force Before and After the Iron is Inserted Between the Poles.

poles of a magnet are measured and then when a piece of iron whose permeability is to be discovered is placed in this magnetic field its field is also tested. If the lines of force of the iron are divided by

the lines of force of the original field the permeability is obtained. The permeability is generally represented by the Greek letter mu (μ) and the formula is as follows:

$$\text{Permeability} = \frac{\text{Lines of force in iron}}{\text{Lines of force in air}} = \mu.$$

It can therefore be said that permeability is a natural qualification of magnetizable metals. Why one has more permeability than another is, in all probability, dependent upon the ease with which the molecules move when magnetized; but there is no distinct criterion for this, and the two extremes of permeability as found in daily practice are air and Swedish wrought iron. Air is taken as the standard and is said to have a permeability of 1. Wrought iron has a permeability of at least a thousand, depending of course upon its quality. The lines of force are measured with reference to the square centimeter or square inch. If, for instance, a bar of wrought iron produces at its ends more lines of force per square inch than a bar of equal size of steel or cast iron then, as would be shown by previous experiments, the pull would be greatest where the lines of force are greatest per unit area.

THE PRESENT STATE OF WIRELESS TELEGRAPHY.

BY PROF. J. A. FLEMING,
University College, London.

AN ABSTRACT.

A most complete and therefore highly instructive and interesting paper on wireless telegraphy is presented in the following condensed form, embodying the most important points covered by Prof. Fleming in his masterly review of the subject and his reference to the builders of that great etheric arch across the Atlantic, over which destiny ordains that human intelligence shall reach without visible signs from the old world to the new. The paper was presented at the International Electrical Congress, held at St. Louis, Mo., September 12-17, 1904.

Parts of a Wireless Outfit.—Wireless telegraphic apparatus might be summed up by saying that it consists of the following parts: (1) an arrangement consisting of a condenser, inductance and disruptive spark gap in series with each other. (2) Some apparatus such as an induction coil, transformer or high tension alternator or high tension dynamo for charging the condenser, and (3) means for controlling the repeated discharges and cutting them up into groups as required in accordance with some signaling code.

The Transmitter.—All the numerous arrangements of transmitters or wave producers for Hertzian wave telegraphy which have yet been devised are only modifications of three methods and however much patentees have rung the changes upon them or disguised their form for the sake of inducing patent offices to grant a patent, every transmitting arrangement in practical use for wireless telegraphy by electric waves consists simply of an oscillatory circuit in which energy is stored electrostatically and released in the form of electric oscillations, this circuit being generally a nearly closed circuit connected directly or inductively with an open or radiating circuit. The original simple circuit of Marconi in which the energy-storing and radiating circuits were one and the same, being the type from which the other two have been developed.

Various remarkable phenomena are mentioned in the course of Prof. Fleming's article, as, for instance, when he speaks of the electric waves bending around the earth and in addition makes the startling statement that daylight prevented Marconi from reaching more than 700 miles with his waves from Poldhu while at night 2,100 miles could be covered.

The Length of the Waves.—Lord Rayleigh has remarked that Mr. Marconi's achievement in sending electric waves across the Atlantic still required some scientific explanation.

The waves he first employed had a wave length of about 1,000 feet, or say, one-fifth of a mile. The earth being a globe 8,000 miles in diameter, the ratio of the above wave length to this diameter is: 1 : 40,000.

Imagine then an ivory ball 1 inch in diameter placed in a beam of parallel red light. This ball would be illuminated on one-half and dark on the other, and although there would be a very slight diffraction into the geometrical boundary of the shadow, there would certainly be no bending or diffraction of the rays for a distance equal to 45 deg. of a great circle.

Bending of the Waves.—In the case of Marconi's transatlantic wireless telegraphy however, we have electric radiation sent out nearly parallel to the earth at one place and detected at another place distant by 45 deg. of longitude on a great circle. How is it that this bending of the electric radiation takes place? If it is due to a simple diffraction, then it is proportionately to the wave length vastly greater than anything of the kind we find in connection with the ether waves which produce luminous sensations. It may be suggested that we have here one of the facts which indicate that the radiation sent off from an earthed aerial or Marconi radiator is not identical in every way with that sent out from an insulated Hertz oscillator. In the former case the semi-loop of electric strain propagated outwards has its feet or ends guided round the conducting surface over which it moves. The earth takes a very important share in the process, but since it is not possible to sever the earth we cannot ascertain how far the continuity of the earth or sea between the two places is a necessary condition for the unusual degree in which these long electric waves can, as it were, be propagated round the corner. It is clear, however, that more scientific observations are requisite before we can confidently state an opinion as to the part played by the earth in the phenomena.

Daylight Stops the Waves.—Space will only permit a very short reference to the interesting observation of Marconi made in a voyage across the Atlantic on board the steamship Philadelphia in February, 1902, viz—that in long distance wireless telegraphy, a given transmitting arrangement is effective over a greater distance by night than by day. Practically this means that it is rather more difficult to send Hertzian waves long distances through that portion of the atmosphere facing the sun than that portion turned away from it. The same thing may be expressed by saying that it requires a more powerful wave to traverse the sun-lit air. The effect is not detectable under a distance of several hundred miles, but in his transatlantic experiments in 1902, Marconi found that the waves sent out from a particular aerial and transmitter at Poldhu were detectable on the Atlantic at a distance of 2,100 miles by night, but only about 700 by day. Since that day, by modifications of the transmitting plant he has been able to greatly extend the daylight distance.

Prof. Fleming speaks of the production of electric waves, their required number for wireless telegraphic work and the fact that instead of being a steady flow are produced more like a series of detached explosions.

How the Waves are Produced.—Up to the present time no one has discovered any method for producing a powerful electric wave of the Hertzian type which does not involve or depend upon the oscillatory discharge of a condenser of some kind. Necessarily therefore this process

is intermittent. The condenser has to be charged and then discharged, and this process results in the production of a group of decadent oscillations and waves and the process is then repeated. Generally speaking the frequency of the oscillations employed in wireless telegraphy is of the order of a million, and from 20 to 100 oscillations may form a group. The frequency of the charge and discharge period may be from 10 to 100. The time over which the oscillations extend is therefore, as a rule, not much more than 1 per cent. of the whole time. In other words, the actual radiation is taking place only at most during about one-hundredth part of the time the operations are continuing.

This fact has induced many inventors to hope for a more efficient method which shall consist in manufacturing a continuous train of waves resembling those emitted by an organ pipe rather than a series of intermittent explosions.

Although alternators have been made, giving a frequency of 120,000, it is without doubt beyond the limits of practical achievement to construct an alternator having a frequency of a million.

Inertia Necessary to Produce Waves.—In order that the energy may be detached from a wave-making vibrating body in air or water and travel away through the medium in the form of a free wave, it is necessary that the reversal in direction of the mechanical force, or, which comes to the same thing, the acceleration positive or negative of the wave-making body, shall exceed some limit. Otherwise there is no detachment of energy. To put the matter in a popular form, the blow administered to the fluid must be sufficiently sudden to call into operation the inertia quality of the medium, in order that a wave may be detached.

Space Penetrating Power of a Wave.—The loudness of the sound produced by an explosive depends quite as much, if not more, upon the suddenness of the explosion as upon the energy stored up. It has been found for instance that 4 ounces of gun cotton exploded in the air will yield a sound quite as loud as that given by 3 pounds of gunpowder. On the other hand, the production of a continuous sound from a steam or air-siren for coast-signal purposes, involves very large amounts of power; as much as 600 hp. having been in some cases consumed. Reasoning from analogy, the inference is probably correct that the production of a solitary ether wave involves the reversal, with a certain ill-defined but high degree of suddenness, of an electric force, and that the amplitude of the disturbance, and hence, what might be called its space penetrating power, depends quite as much, if not more, upon the extreme suddenness of its creation as upon the amount of energy employed.

Quality of the Spark.—For telegraphic purposes the spark must have a certain quality, which may perhaps be defined by saying that the discharge between the balls must be wholly due to the energy coming out of the condenser and not to any supplied directly by the voltage-producing device, whether transformer, alternator or induction coil. Moreover, these sparks must succeed one another with great uniformity and regularity.

To Cause Successful Radiation of the Waves.—The simplest arrangement for making the closed electric circuit radiate is to connect to it, at one point, a long straight wire or rod called an aerial or antenna, and to connect some other point on the closed circuit to the earth.

In order that the arrangement may radiate effectively, it is, however, essential that the natural electrical time period of the closed circuit shall be adjusted by so selecting its capacity and inductance that it shall be in agreement with the fundamental or with a harmonic of the electrical time period of the aerial or radiating wire.

By the foregoing is meant that, as in music, a note played must be in harmony with a chord in order to avoid dissonance or discord, so in the same sense the electrical conditions must be adjusted or the circuit "tuned" and be, as it were, in electrical harmony with the waves cast off by the radiating wire. This is referred to by Prof. Fleming in the following:

How the Radiator Sends Out Waves.—We may at this stage make brief reference to the nature of the effect propagated through space from the radiator. In scientific language this is called an electromagnetic wave. It consists of a periodic and alternating creation of electric and magnetic force in a plane perpendicular to the direction in whioh the energy is traveling. In the particular case of a Hertz oscillator consisting of a pair of rods in one line, their approximated ends forming a spark gap, the effect produced in outer space, as Hertz showed, consists in throwing off closed loops of electric strain which move outwards from the rod. The mode of production of these electric strain-loops can be deduced from a consideration of the oscillation as consisting in the movement of electrons in the rod rapid enough to bring into play the inertia quality of the medium or ether outside. We may, in fact, consider that the process of generating light consists in such a dispersal of closed loops of electric strain by the vibrating electrons of the atoms.

Do the Waves Interfere With Other Wireless Devices?—It is well known that wave lengths of 30 to 50 feet which travel well over a free sea surface are easily obstructed by houses, buildings or elevations on the ground and that for cross-country work a longer wave length is essential. The writer has found that a wave of about 400 feet in length passes quite easily through the buildings and houses of a large town and has worked with such wave lengths across London. When we consider the mass of iron and lead pipes contained in ordinary houses and the immense entanglements of telegraph and telephone wires overhead in large cities it is surprising to find that an electric wave of this length passes so easily through these obstacles.

It has been shown by striking demonstrations made by Mr. Marconi, both in the presence of the writer and also subsequently of Admiralty officials, that the wave sent out from his power station at Poldhu do not in the least degree affect the working of the instrument which he places on board ship for ordinary supermarine signaling.

Hence the conclusions which have been drawn by those who possess insufficient information, that the working of power stations would play havoc with valuable ship to shore, and ship to ship wireless telegraphy on the Marconi system, are entirely without foundation.

THE TESTING OF TRANSFORMER IRON.*

BY LANCELOT W. WILD.

It is now generally acknowledged that the best way of measuring the losses taking place in transformer iron is to make the measurements by means of a wattmeter. The method of measuring the hysteresis loss with a ballistic galvanometer or by means of Prof. Ewing's hysteresis tester is interesting, but unfortunately of little practical value in the case of transformer iron, unless some independent method of measuring the eddy current losses in the iron can be devised.

The wattmeter method of testing transformer iron determines the total loss taking place in the specimen under test. So far no means has been found of separating the hysteresis loss from the eddy current loss with more than approximate accuracy. As, however, it is only the

*Paper read before Section G, British Association, Cambridge, 1904.

total loss that is required to be known in practice, the separation of the two losses from each other is not of any great importance. The total loss is frequently about double the hysteresis loss alone, and the ratio of the two cannot be taken as constant, but depends upon the frequency, induction, thickness of plates and the quality of the iron.

There is considerable evidence to show that hysteresis varies proportionally to the frequency and as the 1.6 power of the induction. It would appear from experiments carried out on iron rolled from the same bulk but to different thicknesses that hysteresis increases as the thickness of the plates is reduced. This is probably due to the larger proportion of magnetic oxide of iron on the thinner plates as the hysteresis loss in magnetic oxide of iron is very large.

Eddy current losses are sometimes considered to be proportional to the square of the induction, the square of the frequency and the square of the thickness of the plates. This three-square law would hold if the local self-induction of the eddy currents could be neglected. Unfortunately, however, for those who like their mathematics to be simple, the self-induction of the eddies is by no means negligible.

For example, if hysteresis varies as $(\text{induction})^{1.6}$ and eddies varies as $(\text{induction})^{2}$, then the total loss should vary as some power of the induction of greater value than 1.6 and less than 2. In practice it is frequently found, however, that the total loss varies at less than the 1.6 power of the induction, and sometimes even as low as the 1.4 power of the induction. The evidence from tests carried out with the ballistic galvanometer is so strongly in favor of the supposition that hysteresis varies as $(\text{induction})^{1.6}$ that it can only be concluded that the eddy current loss varies as something less than the square of the induction. By assuming that hysteresis varies as frequency it can also be shown by experiment that the eddies are proportional to something less than the square of the frequency.

Eddies vary at something less than the square of the thickness. This, however, is not so well established as their variation with induction and frequency. It is evident on consideration that the fact of the eddies possessing local self-induction would account for the departure from the three-square law, and that the departure would be in the direction previously indicated.

It would appear to be impossible to reduce the laws governing the total loss in transformer iron to a simple formula. It is necessary, therefore, that tests should be carried out under the actual conditions as to induction and frequency with which the iron will be used in practice. It is often found, in comparing two samples together, that the one which is the better at a certain induction and frequency is the worse specimen of the two when the conditions are changed.

In using a wattmeter for testing transformer iron it must always be remembered that the instrument includes in its measurement part of the watts consumed in the instrument itself, either that consumed in the series coil or that consumed in the shunt. It is advisable that the correction necessary from this cause shall be reduced to the smallest possible dimensions. This is best attained by connecting the wattmeter so that the wattmeter registers the loss in its shunt coil. The auxiliary resistance in the shunt circuit should be reduced to the smallest value permissible, bearing in mind that there must be sufficient resistance in the circuit to completely drown the self-induction of the shunt coil itself, otherwise the wattmeter will not read correctly. By winding the transformer iron under test with few turns only, it is possible to arrange that the watts consumed in the shunt coil of the wattmeter shall be quite small.

The simplest way of arranging the circuit for testing a sample of transformer iron is as shown in Fig. 1. An electrostatic voltmeter is connected across the terminals of the winding. The shunt coil of the wattmeter is connected in parallel with the voltmeter and the series coils of the wattmeter are connected in series with everything. The induction is calculated from the voltmeter readings. From the reading has to be deducted the loss in the shunt coil of the wattmeter, and, what is more difficult, the C^2R loss in the winding of the transformer. This loss is by no means negligible, and may be actually greater than the loss in the iron itself if only a few pounds of iron are being tested.

It is far better to arrange the circuit as shown in Fig. 2. The iron under test is wound with three circuits—namely, one primary and two secondary circuits. An electrostatic voltmeter is connected across one secondary. This measures the induction. The shunt coil of the wattmeter is connected across another secondary winding. The series coil of the wattmeter is connected in series with the primary winding. By this arrangement the C^2R loss in the primary winding is eliminated from the wattmeter reading. The shunt loss can be made small and is easily calculated from the ratio of the windings, the reading on the voltmeter and the known resistance of the shunt circuit. Another great advantage is that by varying the windings the wattmeter constant can be varied to obtain good readings on the wattmeter under all conditions.

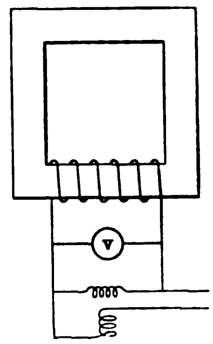


FIG. 1.

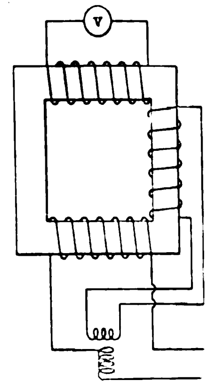


FIG. 2.

This is the method employed at the Westminster Electrical Testing Laboratory. The apparatus used is as follows:

A set of standard coils wound on square bobbins are permanently fixed on to a wooden base. There are six voltmeter coils, three wound with 2,000 turns each and three with 500 each. The coil for the shunt of the wattmeter consists as a rule of 20 turns. The primary coil consists of two turns only and carries up to 50 amperes. The wattmeter is of the reflecting pattern, and, with 160 ohms in series with its shunt coil and the above winding on the iron to be tested, reads up to 11 watts. By varying the windings good readings can always be obtained on both the wattmeter and the voltmeter.

The iron is obtained in the form of strips 7 inches long and 1 inch wide. They are arranged in the standard coils, as shown in Fig. 3, with butt joints and breaking joint in alternate layers.

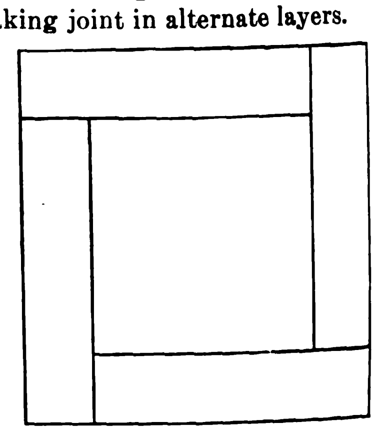


FIG. 3.

Guides are provided to keep the stampings in position. The apparatus takes about 5 pounds of iron.

Before commencing a series of tests it is necessary to determine the physical dimensions of the sample.

We require to know the weight and mean cross-section of the iron. The mean thickness of the iron cannot be sat-

isfactorily measured with a micrometer, as it is generally too small to admit of such measurements being made with more than approximate accuracy.

The mean cross-sectional area of iron is best determined from particulars of the weight, specific gravity and length of each piece. The formula is as follows:

$$\text{Area in sq. cm.} = \frac{\text{Weight of iron in grammes}}{\text{Spec. gravity} \times \text{length of magnetic circuit}}$$

The specific gravity should be obtained by weighing the whole mass of the iron in both air and water. It is not sufficient to take the specific gravity of a single stamping, as there is always a considerable variation between the stampings.

The R.M.S. value of the induction may be calculated by the formula:

$$\mathbf{B} = \frac{V \times 10^8}{2 \times N \times A \times T},$$

where $\mathbf{B}$ = R.M.S. value of the induction, V = reading on electrostatic voltmeter, N = periodicity, A = area of iron, T = turns on voltmeter secondary winding.

The iron loss is generally expressed as so many watts per pound for various values of $\mathbf{B}^{max}$. Where the alternator employed gives a sine wave form, $\mathbf{B}^{max}$ may be found from the R.M.S. value of $\mathbf{B}$ by multiplying by 1.41.

For the sake of uniformity, transformer iron tests should always be carried out with current from a sine wave alternator. If this is not practicable, the form factor of the alternator—i.e., the ratio of R.M.S. voltage to maximum voltage—should always be stated. Since hysteresis is probably the more dependent upon the maximum voltage, and eddies upon the R.M.S. voltage, it is evident that similar results cannot be expected when tests are carried out on widely differing wave-form.

ELECTROLYTIC BLEACHING.*

BY DR. ALFRED GRADENWITZ.

The use of chloride of lime in the bleaching industry, according to the practice of upwards of a century, is attended by many drawbacks. Apart from the instability of this substance with regard to both air and light, and the extremely inconvenient preparation of the corresponding bleaching liquids, there will always remain on the fibers of the tissue a deposit of calcium carbonate, encrusting the latter, preventing a thorough bleaching, and, accordingly, resulting in the goods becoming yellow afterwards. As regards, on the other hand, such bleaching liquids as are obtained by electrolysis, experience has shown for a long time their use to be much more satisfactory than that of chloride of lime; special mention should be made in this connection of the apparatus designed by Mr. Haas and Dr. Oettel, which was one of the first allowing of the electric principle being employed on a commercial scale. We now learn that the inventors have just improved their apparatus considerably, and, therefore, wish to describe their bleaching device both in its original and new forms.

*From the "Electrical Engineer," London.

The system of bipolar electrodes was chosen from the very beginning in the Haas and Oettel apparatus, this system affording the special advantage of reducing to only two the number of contacts to be superintended. The electrodes are made up of a carbonaceous matter, the terminal electrode being formed of two vertical plates, whereas the intermediate electrodes are transverse plates about 1 cm. in thickness, which are inserted into the vertical slots of the apparatus. The sets of intermediate electrodes, so far from filling up the whole height of the apparatus, are each placed on an insulating bar, being prolonged by a similar bar beyond the level of the liquid.

This arrangement is intended for forming at the bottom of each chamber a compartment where impurities may accumulate for a time without endangering the electrolyzer, and, on the other hand, for maintaining the electrode entirely below the level of the liquid, so that any chlorine bubbles, even those evolved on the upper portion of the electrode, are absorbed by the liquid, thus avoiding any disagreeable smell of chlorine in the operation. The sodium chloride solution used as electrolyte enters the first chamber in a concentration of 6.4 deg. Baume, traversing all the chambers in a vertical serpentine path and entering the same alternately beneath and above a partition wall. From the last chamber it is discharged as bleaching liquid into a reservoir, where any smaller impurities due to the salt are deposited. Both at the entrance and issue there are thermometers allowing of the percentage of bleaching liquid being ascertained. On traversing the apparatus, the liquid, in fact, in addition to being chemically altered, becomes heated, experiment having shown a given increase in temperature to correspond with a given percentage in hypochlorite, taken by the salt solution on its passage, the difference of both thermometer readings thus affording a means of regulating and adjusting the speed of the liquid.

The apparatus is free to move in an iron frame, so as to allow of its being readily cleaned by turning the apparatus upwards at 90 degs. Should any electrodes be damaged, only the electrode wall concerned will have to be taken off the apparatus, which, after inserting the new electrodes, will be ready for use again. On account, however, of the considerable life of the specially prepared electrodes, this is of no frequent occurrence, involving no disturbance in the service or any additional expense worth speaking of. The apparatus is designed for various current intensities and voltages, mostly for 65, 110, 120, 220 and 240 volts, as they are frequently connected to existing lighting systems. Now, whereas, some 15 years ago, with the first type of apparatus, rather diluted liquids were required, it has of late years become necessary to increase the percentage in chlorine up to 5, 8 and even 10 grammes, in order to bleach goods that are less easily handled than cotton. It proving not convenient to make the liquid traverse the tank at a slower rate, on account of the inactive chlorate which is then formed, owing to the greater heating effect, means had to be provided for preventing any increase in temperature beyond a certain useful limit.

The result is obtained in the new type of electrolyzer just brought out by Messrs. Haas and Dr. Oettel, Aue (Saxony). In order to convey to the apparatus a continuous supply of cooled liquid without the aid of any external mechanical force, the hydrogen evolved by electrolysis is used to convey the permanently cooled liquid through the electrolyzer quite automatically without any regulation, superintendence or additional outlay being necessary. The underlying principle of this new electrolyzer is as follows: The electrolyzer proper has the shape of a case with a similar arrangement of the electrodes to the original apparatus but for its being entirely fitted into the bleaching liquid reservoir. The various compartments, being locked from each other, are fitted at the bottom with an opening through which the contents of each compartment communicate with the charge of the external reservoir. In the neighborhood of the upper edge each chamber is in addition provided with an overflow tube penetrating also into the liquid reservoir. The latter is filled with salt solution until this reaches the overflow both inside and outside of the electrolyzer. Now, if the current be completed, the liquid in the chambers will rise, forming a violent foam, while overflowing regularly through the tube and sucking fresh amounts of liquid through

the opening in the bottom. The reservoir and chambers form a system of communicating vessels, a solid column of liquid being formed in the former, while the latter contains a mixture of liquid and hydrogen bubbles. As this mixture obviously is lighter, a higher column would be needed to obtain the eqilibrium in the chambers but for the overflow. As long as there is an evolution of hydrogen, there will therefore never be a hydrostatic equilibrium, the liquid being drawn most rapidly through the chambers of the electrolyzer. The fine bubbles of hydrogen carried along will allow of the lively movement and intermixing occurring in the liquid of the reservoir being readily noted over great distances, the more so as this intermixing is aided by the great distance between the inlet and the outlet of the liquid. There are actually but very small differences in the percentage in chlorine throughout the operation in the different parts of the reservoir, this evidencing the high efficiency of the apparatus. The reservoir contains, in addition, a cooling coil, maintaining the temperature of the liquid below 24 degs. C. As the cooling water remains perfectly clean and available for any use, the additional cost of this cooling device is confined to the first cost of the lead coil.

These electrolyzers may readily be adapted to any requirements as regards both the consumption of salt and energy. In countries where salt is expensive, a most perfect utilization of the salt is secured by the construction of the apparatus, whereas in the case of the salt being cheap, the consumption of energy is reduced. In both cases the output of the apparatus may be so regulated as to obtain chlorine at an economical price.

TESLA'S CAUSTIC LETTER.

The following communication from Mr. Nikola Tesla appeared in the New York *Sun* November 27:

"My attention has been called to numerous comments on my letter, published in your issue of November 1, and relating to the electrical equipment of the newly opened catacomb in this city. Some of them are based on erroneous assumptions, which it is necessary for me to correct.

"When I stated that my system was adopted, I did not mean that I originated every electrical appliance in the subway. For instance, the one which that ill-fated electrician was repairing when he was killed, two days after the catacomb was ready for public use, was not invented by me. Nor was that other device on the sidetracked car, which, as will be remembered, caused the burning of two men. I also must deny any connection with that switch or contrivance which was responsible for the premature death of a man immediately afterward, as well as with that other, which cut short the life of his unfortunate successor. None of these funeral devices, I emphatically state, or any of the others which brought on collisions, delays and various troubles and were instrumental in the loss of arms and legs of several victims, are of my invention, nor do they form, in my opinion, necessary appurtenances of an intelligently planned scheme for the propulsion of cars. Referring to these contrivances, it is significant to read in some journals of the 8th inst. that a small firm failed because their bid was too low. This is indicative of keen competition and sharp cutting of prices, and does not seem in keeping with the munificence claimed for the Interborough Company.

"I merely intended to say in my letter that my system of power transmission with three-phase generators and synchronous motor converters was adopted in the subway, the same as on the elevated road. I devised it many years ago for the express purpose of meeting the varied wants of a general electrical distribution of light and power. It has been extensively introduced all over the world because of its great flexibility, and under such conditions of use has been found of great value. But the idea of employing in this great city's main artery, in a case presenting such rigid requirements, this flexible system, offering innumerable chances for breakdowns, accidents and injuries to life and property, is altogether too absurd to dignify it with any serious comment. Here only my multiphase system, with induction motors and closed coil armatures—apparatus unfailing in its operation and minimizing the dangers of travel—should have been installed. Nothing, not even ignorance, will prevent its ultimate adoption; and the sooner the change is made the better it will be for all concerned. Personally, I have no financial or other interest in the matter, except that as a long resident of this city I would have been glad to see my inventions properly used to the advantage of the community. Under the circumstances I must forego this gratification.

"The consequences of the unpardonable mistake of the Interborough Company are not confined to this first subway or even to this city. We are driven to travel underground. The elevated road is the eighth world wonder, as colossal and imposing in the feature of public forbearance as the Pyramid of Cheops in its dimensions Sooner or later all interurban railways must be transformed into subterranean. This will call for immense investments of capital, and if defective electrical apparatus is generally adopted the damage to life and property will be incalculable, not to speak of inconvenience to the public.

"It seems proper for me to acknowledge on this occasion the painstaking suggestions of some friends of mine, mostly unknown to me, both in the large domain of electrical achievement and in the small sphere of my friendship, to again address the American Institute. It is customary with scientific men to present an original subject only once. I have done so and do not desire to depart from this established precedent. A lecture on the defects of the subway offers great opportunities, but would not be original. In view of certain insinuations I may cite a recently published statement of Mr. C. F. Scott, formerly president of the American Institute: 'As a matter of history it is the Tesla principle and the Tesla system which have been the directing factors in modern electrical engineering practice.' There are but a few men whose acknowledgment of my own work I would quote. Mr. Scott is one of them, as the man whose co-operation was most efficient in bringing about the great industrial revolution through these inventions. But the suggestions of my good friends have fallen on fruitful ground, and should it be possible for me to spare time and energy I may ask the city authorities for power to investigate the subway, and make a sworn report to them on all the defects and deficiencies I may discover, in the interest of public welfare.

"A few more words in relation to the signs. With all due respect to general opinion, I entertain quite a different view on that subject. Advertising is a useful art, which is being lifted continually to a higher plane, and will soon be quite respectable. It should not be hampered, but rather encouraged. I would give the Interborough Company every facility for exploiting it, restricting it only in so far as the artistic execution is concerned. A commision of capable men, comprising a painter, a sculptor, an architect, a literary man, an engineer and an executive business man might be appointed, to pass upon the merits of the signs submitted for acceptance. I do not see why the public should object to them if they were regulated in this manner. They will further business, make travel less tedious, and help many skillful artisans. The subways are bound to become

municipal property, and the city will then derive a revenue from them. What is most important for the safety of life and property, quickness and security of travel, should be first considered. All this depends on the electrical equipment. The engineers have built a good tunnel, and proper apparatus should be installed to match it. NIKOLA TESLA.

"New York. Nov. 26."

Design for an Edison Medal.

A meeting of the jury in the matter of a competition for the selection of a design for an Edison medal commemorating the invention of the incandescent lamp, under the auspices of the National Sculpture Society, was held recently at the studio of Mr. J. Q. A. Ward, New York City.

Those present were J. Q. A. Ward, chairman, Daniel C. French, Augustus Saint Gaudens, for the National Sculpture Society; Edward D. Adams and T. C. Martin, for the Edison Medal Association and on behalf of the American Institute of Electrical Engineers.

After a further examination of the 29 designs submitted in competition, the committee by unanimous action, awarded the first prize of $1,000 for the successful design, including its execution in such shape and detail as will permit direct reduction to medal size, to Mr. James Earl Fraser. The second prise of $100 to Mr. Adolph A. Weinman, and the third prize of $50 to Miss Evelyn B. Longman. The successful competitor, Mr. Fraser, has been requested to develop his design for final consideration by the committee.

Proposals Invited.

The Navy Department at Washington, D. C., through the Bureau of Supplies and Accounts, is inviting sealed proposals until December 13, for furnishing the navy yards at Boston, Mass., Newport, R. I., and Portsmouth, N. H., with a quantity of motors, starting panel, rheostat, generating set, signal boxes, controlling apparatus for Westinghouse rotary converters, Sampson cells, desk fans, ventilating set, Weston ground detector, field coils, signal cable, magnet wire, arc lamps, fuse plugs and miscellaneous electrical material. Specifications and blank forms of proposals will be furnished intending bidders upon application to the navy pay offices in the above mentioned cities, or to the Bureau.

New York Electrical Society.

The 246th meeting of the Society will be held at the American Institute, 19 West 44th street, this (Wednesday) evening, November 30, at 8 o'clock. Prof. William Hallock, of Columbia University, will lecture on "Electricity in Physics."

The domains covered by physics and electricity respectively will be indicated, and their relationship will be pointed out. The interdependence of electricity and physics will be illustrated. The most recent theories of the relation of matter to the ether, and of the nature of each will be discussed. Radiant matter of Crookes, Lenard and Roentgen, and canal and Becquerel rays, will be explained and their bearing upon the questions indicated. The mechanics of the conduction of electricity in solutions and gases, ionization, etc., will be discussed, together with electrodeless discharge and its lessons. The nature of the reactions going on in the radioactive substances, their detection and importance will be pointed out. The lecture will be illustrated by lantern slides.

PERSONAL MENTION.

Mr. O. L. Remington, representing Wm. McLean & Co., electrical engineers and contractors of Brownsville, Ind., has arranged to be in New York at the Astor House about December 21 for a few days, and states that he will be open to negotiations from any manufacturer desiring an Australian connection.

Mr. Harold Fulwider of Denver, Col., has been elected president of the Electrical Engineering Society of the University of Colorado. The students composing this society are also student members of the American Society of Electrical Engineers, and as such receive the literature of the society.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOV. 22, 1904.

Electric Railways and Appliances.

775,322. Insulated Rail-Joint. George A. Weber, New York City, assignor to the Weber Railway Joint Manufacturing Company, same place. Filed Jan. 27, 1904.

775,358. Street-Car Fender. Joseph M. Wilderman, St. Louis, Mo., assignor of one-half to Louis J. Ringe, St. Charles, Mo. Filed March 12, 1903.

775,461. Electric Circuits and Apparatus for Railway Signaling. Henry W. Spang, New York City, assignor to James R. Fancher, same place. Filed Jan. 19, 1903.

775,529. Electrically-Operated Railway-Track Switch. George H. Fretts, Springfield, Mass. Filed Jan. 20, 1904.

775,531. Trolley-Pole. Willis E. Harmon, Mechanic Falls, Me., assignor of three-fourths to Charles W. Roepper, Germantown, Philadelphia, Pa. Filed Feb. 9, 1904.

775,592. Insulating-Support for Electric Third Rails. Walter H. Barnard, New York City. Filed July 28, 1904.

775,627. Overhead Trolley. Joseph G. Johnston, Detroit, Mich., assignor to the American Car & Foundry Company, St. Louis, Mo. Filed Sept. 9, 1904.

775,736. Electric Signaling System for Railways. Emilio Sera and Floriano Stolfi, New York City. Filed July 18, 1904.

775,777. Trolley. Edward L. Naret and Joseph R. Ernst, Morgantown, W. Va. Filed Sept. 16, 1904.

775,797. Railway Signaling Apparatus. John T. Cade, Midland Township, Bergen County, N. J., assignor, by mesne assignments, to the General Railway Signal Company, Gates, N. Y. Filed Oct. 6, 1902.

775,808. Trolley. Joseph B. Elker and James F. Tobin, Pittsburg, Pa. Filed Jan. 26, 1904.

775,834-835. Electromagnetic Brake. Robert C. Lowry, New Westminster, Canada. Filed Aug. 13, 1903.

775,836-837. Traction-Increasing Device. Robert C. Lowry, New Westminster, Canada. Filed Aug. 13, 1903.

775,847. Trolley-Wheel. Miles L. Mowry, Greenfield, Mass. Filed March 14, 1904.

775,867. Trolley. William S. Stockton, Philadelphia, Pa. Filed Aug. 18, 1904.

Electric Lights and Appliances

775,442. Electric-Arc Lamp. Tito L. Carbone, Berlin, Germany. Filed April 19, 1904.

775,689. Base for Incandescent Lamps. Alfred Swan, New York City, assignor to the General Electric Company. Filed March 27, 1903.

Electrical Machinery and Apparatus

775,317. Electric Controller. Harry C. Smith and George E. Lippert, Chagrin Falls, O. Filed April 2, 1904.

775,334. Alternating-Current Electric-Motor. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 27, 1904.

775,408. Electrical Register and System Therefor. Louis A. Schmidt, Chicago, Ill. Filed Feb. 5, 1904.

775,409. Power Transmitting and Reversing Mechanism. Robert Symmonds, Kenosha, Wis., assignor to Thomas B. Jeffery, same place. Filed April 9, 1904.

775,416. Electric System of Transmission. Charles G. Burke and Edward J. Burke, Brooklyn, N. Y., assignors of twenty one thirtieths to John Q. A. Whittemore, Boston, Mass. Filed Dec. 17, 1903.

775,439. Alternating-Current Motor. Ernest J. Berg, Schenectady, N.Y., assignor to the General Electric Company. Filed April 9, 1904.

775,445. Controlling-Switch for Electric Circuits. Maxwell W. Day, Schenectady, N. Y., assignor to the General Electric Company. Filed May 9, 1904.

775,453. Regulating Dynamo-Electric Machines. Wilbur L. Merrill, Schenectady, N. Y., assignor to the General Electric Company. Filed June 11, 1902.

775,458. Dynamo-Electric Machinery. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company. Filed May 9, 1902.

775,501. Controller. Ernest Schattner, Schenectady, N. Y., assignor to the General Electric Company. Filed May 13, 1904.

775,665. Circuit-Controller. Archibald D. Scott, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed Nov. 6, 1903.

775,692. Electromagnetic Circuit-Controller. Eugene W. Vogel and Charles H. Morrison, Chicago, Ill., assignors to the Railroad Supply Company. Filed March 21, 1902.

775,844. Electric Time-Switch. Clifford S. Moore, Holyoke, Mass., assignor of one-half to Burton C. Read, same place. Filed Dec. 23, 1903.

775,857. Dynamo-Electric Machinery. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company. Original application filed May 9, 1902. Divided and this application filed May 18, 1903.

775,891. Apparatus for Generating Electric Currents. Charles S. Bradley, Avon, N. Y. Filed Sept. 11, 1897.

Telephones and Telephone Apparatus

775,337. Wireless Telephone. Roberto L. de Moura, New York City. Filed Oct. 4, 1901.

775,521. Telephone System. George M. Crockett, New York City, assignor of one-half to Irving H. Brown, Plainfield, N. J. Filed June 19, 1903.

Miscellaneous.

775,390. Electrical Signaling Apparatus. Sewall Cabot Brookline, Mass. Filed March 23, 1904.

775,472. Method of Converting the Energy of Fuel into Electrical Energy. Hugo Jone, Chicago, Ill. Filed Nov. 18, 1901.

775,637. Telegraph Pole. Wilhelm Schutz, Cassel, Germany. Filed May 2, 1903.

775,654. Electric Furnace. Aldus C. Higgins, Worcester, Mass. Filed April 4, 1904.

775,714. Electric Heater. Edward P. Weggen, Jefferson City, Mo., assignor of two-thirds to Charles Tweedle, same place, and William J. Schott, Topeka Kan. Filed April 22, 1904.

775,723. Electric Burglar-Alarm. Amos Getto, New York City. Filed April 27, 1904.

775,732. Battery Charging Apparatus. Hermann G. Pape, New York City. Filed May 17, 1904.

775,846. Wireless Telegraph. Roberto L. de Moura, New York City. Original application filed Oct. 4, 1901. Divided and this application filed Jan. 16, 1902.

775,892. Galvanic Element or Battery. Paul Brandt, Schoneberg, near Berlin, Germany. Filed April 20, 1904.

THE TELEPHONE WORLD.

Independent Long-Distance Line Completed by Vanderbilts.

The Vanderbilts have completed their independent long-distance telephone line between New York and Chicago. The Lake Shore & Michigan Southern Railroad Company constructed one part of the line, between Chicago and Buffalo, and the New York Central officials constructed the other part, along the route of the West Shore road, between Buffalo and Weehawken. All that now remains is to carry the system from Weehawken to the Grand Central Station. A special two-strand cable is to pass under the Hudson. The two railroad systems will then have a complete independent telephone circuit.

The construction of this line has aroused much speculation in railroad and electrical circles, and there is a general belief—a suspicion, at least—that the Vanderbilts intend sooner or later to abandon the telegraph and dispatch their trains by telephone.

Starting with Chicago, there are five stations from there to Buffalo which are equipped with switchboard facilities, namely, Chicago, Toledo, Cleveland, Ashtabula and Buffalo. At all these cities a private branch exchange switchboard is installed in the railroad station. These boards, through an agreement with the Bell Telephone Companies in the several States are connected to the Bell switchboard.

By means of the switchboards it is feasible to break the line up into sections and carry on conversations between several stations simultaneously, for instance between Chicago and Cleveland, and between Cleveland and Buffalo, or the operator can talk direct from Chicago to Buffalo. At Elkhart, Ind., the master mechanic of the Lake Shore system has his office, and the telephone is especially valuable at that point.

The Vanderbilt telephone line is of No. 8 copper wire, strung on telegraph poles. Between Buffalo and New York the line was strung on the West Shore poles because they were in better condition.

Northwestern Telephone Men to Meet.

The Independent telephone men of the Northwest will hold their annual meeting in Sioux Falls, S. D., in January. The exact date has not yet been determined upon. The territory covered by the Independent wires is all of South Dakota east of the Missouri River, Southwestern Minnesota and Northwestern Iowa. From 75 to 100 delegates are expected to be present.

The telephone line from Lewisburg to Yell, Tenn., has been completed. The completion of this line gives Marshall County splendid service.

The Citizens' Telephone Company of Hamblen County, Tenn., located in Morristown, has amended its charter, increasing its capital stock to $18,000.

The Mexico-Laddonia Telephone Company has asked for a franchise to establish a city exchange in Mexico, Mo.

The people of Chipman, N. Y., are becoming quite well connected by telephone, and more lines are in process of construction.

Cumberland Company has Rival in Paris, Tenn.

The Legislative Council of Paris has granted to local capitalists a franchise to establish and conduct a telephone system in that city for 50 years. These gentlemen, in conjunction with a number of wealthy citizens of Memphis and elsewhere, intend to establish a thorough system in Paris, and among other new features will use underground wires. This is the first rival that the Cumberland Company has ever had there, and it is announced that it has money enough behind it to make it a formidable competitor.

Henry County has a complete system of telephones, two local companies in addition to the Cumberland Company, reaching nearly every neighborhood, while a new line from Benton County is being surveyed, and the right of way into Paris has been applied for.

New Independent Company in the Field.

Articles of incorporation of the Council Bluffs, Ia., Independent Telephone Company have been filed for record.

The capital stock is $100,000, divided into 1,000 shares of $100 each, which must be fully paid up when issued. Money, property or service may be taken in payment for stock.

The officers are: President, E. H. Lougee; vice president, E. H. Merriam; secretary, F. J. Day; treasurer, E G. Turner; directors, Messrs. Davis, Keys, Merriam, Turner, Lougee, Beno, Everett, Day and Bloomer.

The objects of the incorporation, as stated by the articles, are to establish a telephone exchange in Omaha, Neb., to connect with any Independent company desiring such connection, to maintain toll lines, to manufacture and deal in electrical apparatus and to maintain a messenger service.

Persons interested in the project have been engaged in the promotion of the new company for several months. Several conferences have been held with Independent telephone owners in Western and Southern Iowa, and numerous meetings of the promoters and Omaha capitalists whom they hope to interest have been held.

Telephone service in Northampton, Mass., will be vastly improved within the next few months by the adoption of the underground conduits, and when the building under process of construction is completed the local exchange will have conveniently arranged and well equipped quarters. Every department will be supplied with the most modern apparatus and the local service will be incomparably superior to the present. It is the intention of the company to eventually do away with party lines, changing the system gradually, until this is accomplished.

Long-distance connections have recently been made by the Riverside, Cal., Home Telephone Company. About 600 subscribers have been secured, and the company expects to have its system installed by January 1.

Reports of a war between Independent telephone interests in Ohio and the Central Union (Bell) Company, were lately denied by T. P. Sylvan, of the Central Union Telephone Company.

Telephone Gift for Chicago.

The city of Chicago expects to go into the telephone business at the end of 26 years, if not sooner, for at the end of that term the telephone plant and system of the Illinois Tunnel Company reverts to the city gratis.

Under these conditions people are inquiring if it is business wisdom to help build up by future ordinances the Chicago Telephone Company, which will be the city's rival in the business. The franchise of the Chicago Telephone Company expires in a few years, and already talk of extending it is heard. It is necessary that the company should have some sort of an extension if it is to continue in business.

Telephone Company Can Build Line.

Justice Kenefick has issued an injunction restraining the village of Hamburg, N. Y., from interfering in any way with the Interocean Telephone Company in the work of constructing a telephone line in Long avenue.

The work recently was stopped by a village police official, acting under orders from the village board. The telephone company claims it obtained authority to construct the line in 1899.

The Interstate Telephone Company is extending its lines southward from Newville, N. Y., into the town of Stark, where local telephone facilities have been very limited. It is the policy of the Interstate and associated Independent companies to encourage rural individual 'phones instead of forcing people to reach toll stations to communicate with the outside world, in cases of emergency, often at rates practically prohibitory to those of moderate means, making this invention a luxury for the rich instead of a necessary convenience for the masses.

It was given out at the convention of the Michigan Telephone Company's upper peninsula district managers, that an additional long-distance line is to be constructed from Detroit to St. Ignace, and eventually to Marquette, business having increased to such an extent as to heavily tax present facilities. The meeting, which was attended by President Jackson and General Manager Land, of Detroit, in addition to 10 Northern Michigan district managers, was the first of the kind yet held, but will be made a semi-annual practice. The company's business everywhere was reported in a very prosperous condition.

After six months' work in Covington, La., in constructing a model telephone system, J. J. Sullivan, manager of construction for the Cumberland Telephone Company, left for New Orleans. The company has expended about $12,000 in extensions and enlargements.

Telephone Incorporations.

The Leonardsville Telephone Company, Leonardsville, N. Y. Capital stock, $1,000. Incorporators: E. S. Brand, J. A. Crandall and A. M. Coon, all of Leonardsville.

The White Oak Telephone Company, White Oak Springs, Wis. Capital stock, $2,500. Incorporators: H. A. Beckwith, Joseph Edge and Mrs. S. J. Coulthard.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Anadarko, Okla.—The city council has decided to build a municipal electric lighting plant, and has employed an engineer to furnish estimates and plans.

Ballard, Wash.—The city council has been asked by Louis V. Brewer to grant him a franchise for installing and operating an electric light plant here.

Bartlettsville, Ind.—Samuel J. Smallwood has obtained a franchise for the installation of an electric light plant here.

Bellefontaine, O.—The municipal electric light plant of this city is out of repair and the city officials are considering a proposition to sell it to a private company. A representative of the Ft. Wayne Electrical Company has been here looking over the plant, with a view to making an offer.

Bridgeton, Pa.—The city council is contemplating the erection of an electric lighting plant, and furnishing illumination for the city streets.

Cape Charles, Va.—Heckle & Kellogg have applied for a franchise to erect and operate an electric light plant.

Chrisney, Ind.—The Chrisney Electric Light Company has been incorporated with a capital stock of $1,500. J. C. Felia, B. N. Fish, J. M. Felia, John B. Chrisney and others are the incorporators.

Cookeville, Tenn.—The citizens will vote December 2 on the issuance of $25,000 of bonds for the construction of the proposed waterworks and electric light plant.

Crab Orchard, Neb.—This place is soon to have electric lights, as a stock company has been organized here with a capital of $2,500, and work on the building has already commenced.

Dalton, Ga.—The city council has decided to put in a light and power plant to furnish electric power and lights to the smaller plants in this city. Address the mayor.

Dayton, O.—The Dayton Electric Light Company is preparing plans for an underground system to cover the entire city, in which the electric light conduits will be placed.

Gaylord, Mich.—The electric lighting plant here was entirely destroyed by a recent fire.

Gifford, Ill.—It is rumored that William Wooldridge and W. H. Piper contemplate putting in an electric light plant here.

Hazel Green, Wis.—The village board will install its water and electric plant in the near future.

Hibbing, Minn.—A new dynamo and switchboard are to be installed in the city electric light plant.

Jefferson City, Mo.—At a special election held here November 15, a proposition to grant a 20-year franchise to a Chicago syndicate to furnish electric and gas light to this city was carried.

Knoxville, Tenn.—Local sentiment is being aroused for an electric light plant, and it is very probable that the next Legislature will be asked to allow the city to issue bonds for that purpose.

Lyons, Ga.—The people are now planning for an electric light plant, and it is probable that the plant will be in operation by January 1 or soon after.

Marianna, Fla.—The Graceville Electric Light & Water Company will issue bonds to the amount of $15,000, to make extensive improvements to its plant. Robert J Boone, of this city, is secretary.

Memphis, Mo.—D. A. Frazee and J. K. Shackett have petitioned the town council at Gorin for an electric light franchise.

Memphis, Tenn.—This city is considering the municipal ownership of the electric light plant.

Minneapolis, Minn.—The Joyce-Pillsbury Company of this city has been organized to conduct a lumber business and to build and operate an electric lighting plant. Its capital stock is $100,000. William J. Joyce, of Chicago, H. C. Ackley and F. C. Gebhard, of Minneapolis, are interested.

Montague, Mich.—This city is to have electric lights.

Norton, Kan.—A company has been formed here, the purpose of which is to establish an electric lighting and ice manufacturing plant.

Pekin, Ill.—The electric light company is making an effort to improve the lighting system on the north side.

Pocahontas, Ark.—S. D. Dorrell, a banker and real estate broker of Walnut Ridge, and George E. Wells, an electrical engineer of St. Louis, have been interviewing the city councilmen in regard to a franchise for an electric light plant. It is stated that the same will likely be granted. Mr. Dorrell says he has sufficient backing to put in a good plant, one that will cost something like $25,000.

Richmond, Va.—This city contemplates employing an electrical expert to investigate and report on the location and cost of an electric light plant. The mayor may be addressed.

Staunton, Va.—The board of trade passed resolutions petitioning the council to enlarge the city electric light plant.

Upland, Pa.—The capitalists here are planning to establish an electric light plant.

STREET RAILWAYS.

Berkley, Va.—Work has been commenced on the piling for the new electric marine railway of Capt. Charles J. Colonna, on the southern branch of the Elizabeth River, on the site of the old railway.

Buena Vista, Col.—Superintendent Leigh, of the American Crude Rubber Company, says that besides the erection of an extraction plant it is the intention of the company to construct an electrical street railway, not only to haul the raw material to the plant here, but for the transportation of ore from the mines to the railroads in this city.

Cleveland, O.—It is said that a third rail line will shortly be constructed connecting this city, Ravenna, Congress, Lake, Canton, Zoar and Canal Dover. J. V. Ware, of this city, is said to be back of this scheme.

Corunna, Mich.—Frank Westcott has been here and at Durand and Gaines Station with petitions asking for a franchise and right-of-way through those villages for the electric road from Owosso to Pontiac.

Council Bluffs, Ia.—A proposition to build an electric railway line from Carson to this place, will be discussed at a meeting of the promoters to be held at Carson.

Gaylord, Mich.—Local capitalists are interested in a proposed trolley line between here and Otsego.

Indiana, Pa.—A new electric railroad is to be built out of this city just as soon as the rights-of-way are secured, and these are being pressed forward with as much energy as possible. The head of the new concern is Judge John P. Elkin, who is associated with a number of Eastern men in the enterprise.

Joliet, Ill.—The Chicago-Joliet Electric Railway Company will have a complete double track between this city and Chicago.

Kenosha, Wis.—A company is being formed to build a new electric railway line between this city and Lake Geneva. Work will begin early in the spring.

New Haven, Conn.—The link has been completed between this city and Wallingford, which gives a direct trolley line between New York and Boston.

Oshkosh, Wis.—The Fond du Lac & Oshkosh Electric Railway Company is planning to build another through line.

Paducah, Ky.—Work is expected to be started soon on the electric railway between here and Cairo, Ill. The cost is to be $800,000.

Santa Cruz, Cal.—The consolidation of the Santa Cruz Electric Railway Company and the Watsonville, Capitola & Santa Cruz Electric Railway Company is now complete. The new concern will hereafter be known as the Union Traction Company. E. A. Cole has been appointed superintendent.

Steubenville, O.—The commissioners of Jefferson County have granted L. W. Healy and others of the East Liverpool Railway a franchise to build a road from Empire to the Jefferson County line. From East Liverpool the Healy lines will be built to Beaver. There is a completed line from Wheeling to Empire now.

POWER PLANTS.

Comstock, Neb.—The Middle Loop Electric Power Company proposes to construct an electric power plant here.

Hinsdale, Mass.—Civil engineers have been at work lately taking measurements and setting stakes for dams and canals along the unoccupied water power of the Housatonic River between the Hinsdale mills here and the Renfrew mills in Dalton, with a view of developing the power in the river for generating electricity for transmission.

BIDS WANTED.

Burlington, Vt.—The bids for equipping Fort Ethan Allen with electric lights have been opened and rejected by Capt. T. B. Lamoreux, quartermaster general of the army, and new bids will be requested.

Cleveland, O.—Specifications for an engine, dynamo and switchboard for the new power plant at the Newburg State Hospital were approved by the trustees; if the State officers approve, bids will be immediately advertised for.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 14¾@15c.; Lake 14⅞@15⅛c.; casting, 14½@14¾c.

It is reported in Philadelphia that the papers transferring the Keystone Telephone property to the Sheldon syndicate have already been signed and that the deal is practically completed.

When the New Orleans Railways Company has reduced its capital from $80,000,000 to $60,000,000 the State will withdraw its suits against the company for violation of the over-capitalization law.

It is reported that the New York Central & Hudson River Railroad Company will begin at once to equip its New York & Harlem branch with electricity, instead of waiting a year as it at first intended.

George C. Webb has been appointed receiver of the Blue Grass Traction Company, which was incorporated in Lexington, Ky., three years ago by Senator George B. Davis, of Detroit, with a capital stock of $7,000,000.

Receiver Henry A. Blair and President Rawson of the underlying companies of the Chicago Union Traction system have sent out to all stockholders in these companies letters requesting their proxies at the annual meeting January 10.

The Houston-Galveston Interurban Railroad Company has increased its capital stock from $1,000,000 to $2,000,000. This company claims to have all plans arranged for an electric railway between Houston and Galveston, Tex., a distance of 50 miles.

Accompanying the recent advance in General Electric stock have been reports that the dividend would be increased to 10 per cent. per annum and that there would probably be further rights to subscribe to new stock at par, incident to a large extension of the turbine engine business.

A syndicate has purchased from the Detroit United Railways Company $8,200,000 of its first consolidated mortgage 4½ per cent., 30-year gold bonds, due January 1, 1932. These bonds are a part of an issue of $25,000,000 which will eventually be a first mortgage on the entire property.

Contending that the underlying stockholders furnished the money and guaranteed the bonds by which the Consolidated Traction Company and the Union Traction Company of Chicago originally were operated and equipped, and that these stockholders are the real owners of the Consolidated Traction Company, suit is to be started by the underlying stockholders to establish ownership.

The positive statement is made that William K. Vanderbilt now owns all but 35 shares of the Niagara, Lockport & Ontario Power Company, and that he is preparing to spend $10,000,000 in its construction. Contracts involving an expenditure of nearly $5,000,000 will be let within four weeks. Work will be begun before January 1. It is believed that the company will sell nearly all of its 200,000 horse power to the New York Central.

The St. Louis Transit Company, which formerly held the common stock of the United Railways Company of St. Louis, is now in process of liquidation, the Transit stock being exchanged for United Railways common. The Transit Company's collateral 5 per cent. notes amounting to $5,000,000 were paid off on November 1. It is estimated that the Railways Company will show net earnings this year of $4,218,000 compared with interest charges of $1,886,000

ELECTRICAL STOCK QUOTATIONS.

Name	Closing price Nov. 28
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	168
Metropolitan Street Railway	122¾
Metropolitan Securities	81½
Ninth Avenue	197
Third Avenue	132
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	68½
Public Service Corporation (New Jersey)	110
Philadelphia.	
Consolidated Traction of New Jersey	77½
Philadelphia Traction	98
Union Traction	59
Boston.	
Boston Elevated	154⅛
Massachusetts Electric Companies, com	16
do. do. do. pref.	62½
West End Street, com	92
do. do. do. pref.	112
Chicago.	
City Railway	188
North Chicago	79
Union Traction, com	13¼
do. do. pref.	46
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	20¼
do. pref.	71
Electric Boat, com	43
do. do. pref.	66
Electric Lead Reduction	½
Electric Vehicle, com	17
do. do. pref.	24
Westinghouse, com	182½
do. pref.	194
General Electric	190½
Boston.	
Edison Electric Illuminating	250
General Electric	191
Westinghouse Electric & Mfg., com	92
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	45
do. do. pref.	110
Philadelphia.	
Electric Company of America	10⅞
Electric Storage Battery, com	82
do. do. do. pref.	82
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	148½
Western Telephone Company	20
New England Telephone Company	138
New York.	
American Telegraph & Cable Company	93½
Commercial Cable Company	210½
Mexican Telephone Company	2½
New York & New Jersey Telephone Company	158½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	91⅜
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49
Consolidated Car Heating	64
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CONTENTS.

EDITORIAL NOTES.

The Electric Heating Situation.

The world is continually asking why electric heating is not in vogue in place of stoves and steam heat. They say it is hygienic, compact and under control with a touch of the button. We confess that all this is true and even more. It represents a return of 100 per cent. for the power consumed. This being the case why is electric heating for homes and hotels so dilatory in coming to the front? Is the public to blame or is the electrician? Let us find out by examining the situation from a common sense standpoint.

A triple expansion engine supplying power to the generators of a lighting and power plant has a net efficiency of about 14 or 15 per cent. This means that for every hundred weight of coal consumed about six-sevenths goes up the chimney in smoke. Or to be more accurate, the heat energy is largely wasted through radiation and the familiar influences which pull down the general efficiency of a steam plant. When the remaining one-seventh emerges, after having passed through various channels of transformation, it appears as electricity. In this form it may be considered in connection with the problem of electric heating.

Here is the case in a nutshell: In a heating system which provides hot air or burns the coal in stoves, radiation of the heat is just the thing desired, and if steam heating is employed here again radiation of the heat into the room is all right. In these cases there is, as heat, a much greater return for the coal burnt than if its energy had been passed through various devices which give us electricity in the end, which is then again transformed into heat in the electric heater.

Coal burnt directly in stoves to give heat yields about twice as much heat at least, for a given number of pounds, as when its energy undergoes a variety of changes which culminate in electric heat.

The trouble is not with the heater, neither can it be found in connection with the power, because, as already stated, the return in this case is 100 per cent. The difficulty is with the cost of electricity. Selling electricity at so much an ampere hour or so much a horse power hour means charging at least four cents for every four or five pounds of coal burnt. The heat obtained by electrical means from this handful of coal is not sufficient to pay for its use in this form.

A hundred weight of coal burnt in a stove warms a room of moderate size very well in cold weather. Turned into electrical energy, one hundred weight of coal yields about 15 hp. hours. This cannot give the requisite heat, and cannot compare in heat-giving capacity even with 100 per cent. electric heaters, from a financial standpoint, with the old-fashioned method. The trouble is, as already stated, a dollar and cents one. It is entirely due to the heavy cost of electricity.

* * *

A Talk With Electrical Beginners.

In a recent address before the institution of Electrical Engineers in Dublin, Ireland, Mr. Mark Ruddle, the city electrical engineer, made some interesting remarks upon the questions which demand consideration from young men at the commencement of their training for the electrical engineering profession. He stated that a municipal engineer is often looked upon as an encyclopædia of information as well as a universal provider of employment. One often hears the remark made, "Oh, So-and-so is a 'born

engineer.'" To a certain extent this is, of course, true, but in the ordinary meaning of the term, as implying that the person in question had no difficulty in acquiring his engineering knowledge, we venture to think that these "born engineers" exist only in imagination.

According to Mr. Ruddle the task of keeping the training of students for the profession of electrical engineering abreast of current practice seems almost hopeless in the face of the present rapidly increasing rate of development, and this leads to the important question whether it is advisable for the various colleges and technical schools to confine themselves to the teaching of the scientific principles which underlie engineering in general and the electrical branch in particular, or whether they should supplement that course by practical information upon the construction and operation of the various types of machines themselves, which would, of necessity, require that the equipment should be kept up to date by the newest and most efficient types of actual plant.

One predominant fact appears certain, that one course of general training is necessary for those men who have the ability and funds for qualification into the higher branches of the profession, and that an entirely different training is required for those who, under ordinary circumstances, will have to commence their career with the routine work of the many applications of electrical engineering.

The question seems to hinge largely upon the syllabus of the primary and secondary education received up to the age of 16. Much, however, depends upon the student himself. If he has an innate love of the science and art of electrical engineering, and of learning for the sake of finding out hidden things; if he has the earnest desire to attain to as near the front rank as his capabilities will permit, and has the physical and mental constitution to stand the strain of burning the candle at both ends, so to speak, he will, with average good fortune, attain his end more surely than many others who start under more, apparently, favorable auspices, for, having the self-stimulus of an insatiable knowledge-hunger, he is in closer sympathy with his teachers, and does not wait to be spurred on in his work. And this is the true spirit which should animate those seeking to enter the engineering profession. Its devotees must give more than lip-service—answering of examination questions and obtaining passes and certificates—for these alone are no test of a man's fitness, and, in fact, are often the cause of much wasted time by giving a premium to those who best develop a parrot-like facility of answering set questions rather than probing the depth of the information they have assimilated.

A serious danger is now developing owing to the great inrush of young men into anything electrical in name; many of them seem satisfied to acquire just enough technical knowledge to secure a post. Once secured they settle down and perform their routine duties more or less thoroughly, and gradually drift out of keeping their training up to date.

The author concludes as follows: "I have hitherto dealt principally with the technical side of a student's training, but before a student can expect to secure a position of any importance he has yet to acquire the commercial or business side of his education. No technical training institute can teach a student how to handle workmen, or how to turn out finished plant from a workshop at commercially remunerative prices, nor would it be reasonable to expect it to do so, for such knowledge can only be gained in the hard school of practical experience, and learnt little by little as opportunity offers. And yet such is the ultimate object of all profession training in the majority of cases, for the most perfectly and scientifically designed is quite valueless unless it can be made a commercially financial success. Students should, therefore, take every opportunity of seeing works in practical progress; they feel utterly at sea with regard to much that goes on, but to an observant mind there are many object lessons to be learnt and hints obtained which will be of much service in after life. Ask questions about everything is my advice to students; never mind whether they may appear foolish or trivial, give evidence in some way that you appreciate your opportunity, and you will gain many valuable hints for your future work, and render the task of your instructors a little easier."

The two expert electrical engineers, Messrs. Stone and Webster, appointed by the Navy Department to examine into the advisability of consolidating the electric light and power plants at the various navy yards along the Atlantic coast, have made their report. They recommend that the plants be consolidated "at the most favorable point in each yard, placing the entire power production and distribution in the hands of one department." It is estimated that a central power plant at the New York Navy Yard, will save the Government $30,000 per year.

UNDER THE SEARCHLIGHT

Notes and Comments on Various Topics.

The fiftieth meeting of the American Society of Mechanical Engineers is now being held at the society's parlors, 12 West 31st street, New York City. The closing session will be held on Friday morning. The annual reception will be held at Sherry's to-morrow evening.

The Board of Estimate of New York at its last meeting adopted a resolution, on motion of Controller Grout, directing the Corporation Counsel to prepare a bill, to be presented at the next Legislative session, so amending the charter as to permit the city to build an electric plant for the lighting of streets, parks and public buildings.

Prof. Ernest Rutherford of McGill University, Montreal, has been awarded the Rumford medal by the Royal Society of London, for his researches in radioactivity and for his discovery of the existence and properties of the gases emanating from radioactive bodies.

William Barclay Parsons, chief engineer of the Rapid Transit Commission for the past ten years or more, has resigned. The resignation was not unexpected as Mr. Parsons is a member of the Panama Canal Commission and also desires to go into private business as a consulting engineer.

The Great Northern and Northern Pacific Railroad Companies want to substitute electric motors for their heaviest freight engines. An expert from one of the largest electric manufacturing concerns has spent several weeks investigating the question of electric traction on the Northern Pacific and Great Northern roads in the Rocky Mountains. He reports that the water power in the cascades is sufficient to furnish electricity for motors to take the place of steam engines on the mountain divisions, and that the cost of furnishing electric power will be much less than the cost of the coal used in engines.

During the past few years the use of oil as fuel has grown with great rapidity, and is attaining its most important developments as a fuel on the railroad and steamship lines. It is said on good authority that the crude oil is a perfect substitute for coal where the requisite arrangements have been made for its consumption.

THE DEVELOPMENT AND USE OF HIGH SPEED TOOL STEEL.*

BY J. M. GLEDHILL.

Where electric current is available, the system of electric heating is quick, reliable and economical.

One method of electrically heating the points of tools and the arrangement of apparatus is shown in Fig. 1. It consists

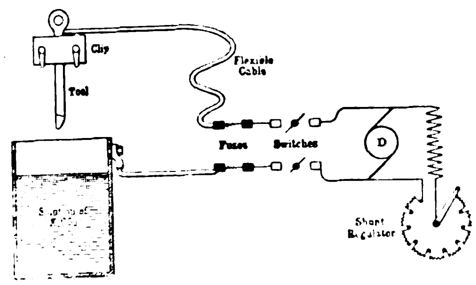


FIG. 1.
Apparatus for Electrically Hardening Tools.

of a cast-iron tank, of suitable dimensions, containing a strong solution of potassium carbonate together with a dynamo, the positive cable from which is connected to the metal clip holding the tool to be heated, whilst the negative cable is connected directly to the tank. The tool to be hardened is held in a suitable clip to insure good contact. Proceeding to harden the tool the action is as follows: The current is first switched on, and then the tool is gently lowered into the solution to such a depth as is required to harden it. The act of dipping the tool into the alkaline solution completes the electric circuit and at once sets up intense heat on the immersed part. When it is seen that the tool is sufficiently heated the current is instantly switched off, and the solution then serves to chill and harden the point of the tool rapidly, so that no air blast is necessary.

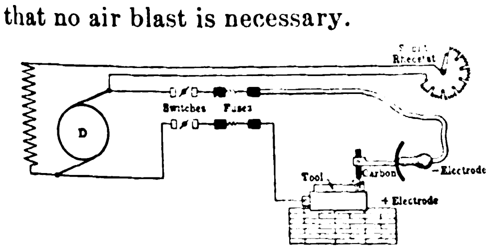
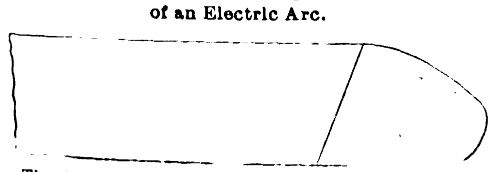


FIG. 2.
Apparatus for Hardening High-speed Tools by means of an Electric Arc.



The shaded portion shows the area of electrical contact. The negative electrode should be kept moving over the surface without approaching too near the cutting edge of the tool.

Another method of heating the point of tools is by means of the electric arc, the heating effect of which is also very rapid in its action. The general arrangement and form of the apparatus here employed being as illustrated in Fig. 2.

The tool under treatment and the positive electrode are placed on a bed of non-conducting and non-combustible material and the arc started gradually at a low voltage and steadily increased as required by controlling the shunt rheostat, care being taken not to obtain too great a heat and so fuse the end of the tool. The source of power in this case is a motor generator consisting of a continuous-current shunt-wound motor at 220 volts, coupled to a continuous current shunt-wound dynamo at from 50 to 150 volts. Arcs from 10 to 1,000 amperes are then easily produced and simply and safely controlled by means of the shunt rheostat.

Tempering.—Electricity is also a very efficient and accurate means of tempering such forms of tools as milling, gear, hobbing and other similar cutters, also large hollow taps, hollow reamers, and all other hollow tools made of high-speed steel, where it is required to have the out-

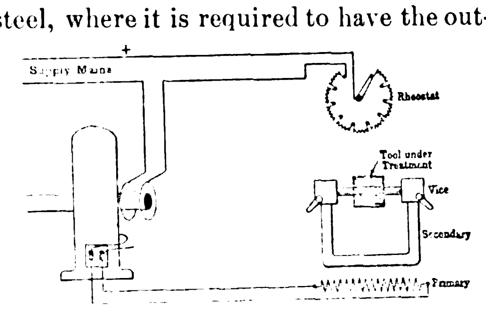


FIG. 3.
Apparatus for Tempering Milling Cutters, etc., Electrically.

side or cutting portion hard, and the interior soft and tenacious, so as to be in the best condition to resist the great stresses put upon the tool by the resistance of the metal being cut, and which stresses tend to cause disruption of the cutter if the hardening extends too deep. By means of the apparatus illustrated in Fig. 3 this tempering or softening of the interior can be perfectly and quickly effected, thus bringing the cutter into the best possible condition to perform rapid and heavy work. Tempering of hollow cutters, etc., is sometimes carried out by the insertion of a heated rod within the cutter and so drawing the temper, but this is not entirely satisfactory, or scientific, and is liable to induce cracking by too sudden heat application, and further, because of the difficulty of maintaining the necessary heat and temperature required, and afterwards gradually lowering the heat until the proper degree of temper has been obtained.

In electrical tempering these difficulties are overcome, as the rod is placed inside the cutter quite cold, and the electric current gradually and steadily heats up the rod until the correct temperature is reached, when it can be held at such temperature as long as is necessary, and the current can be gradually reduced until the articles operated on are cold again, and consequently the risk of cracking by too sudden expansion and contraction is reduced very greatly. The apparatus used is very simple, as will be seen by reference to the sketch. It consists of a continuous current shunt-wound motor directly coupled to a single-phase alternating current dynamo of the revolving field type giving 100 amperes at 350 volts, 50 cycles per second, the exciting current being taken from the works supply main. The power from the alternator is by means of a stepdown transformer, reduced to current at a pressure of 2 volts, the secondary coil of the transformer consisting of a single turn of copper of heavy cross section, the extremities of which are attached to heavy copper bars carrying the connecting vices holding the mandril upon which the cutter to be tempered is placed. The secondary induced current, therefore, passes through a single-turn coil, through the copper bars and vices and mandril. Although the resistance of the complete circuit is very low, still, owing to the comparatively high specific resistance of the iron mandril, the thermal effect of the current is used up in heating the mandril, which gradually attains the required temperature, slowly imparting its heat to the tool under treatment until the shade of the oxide on the tool satisfies the operator. The method adopted to regulate the heat of the mandril is by varying the excitation current of the alternator by means of the rheostat. An extremely fine variation and perfect heat control is easily possible by this arrangement.

*Abstract of paper presented before the Iron and Steel Institute of New York.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

BATTERIES.

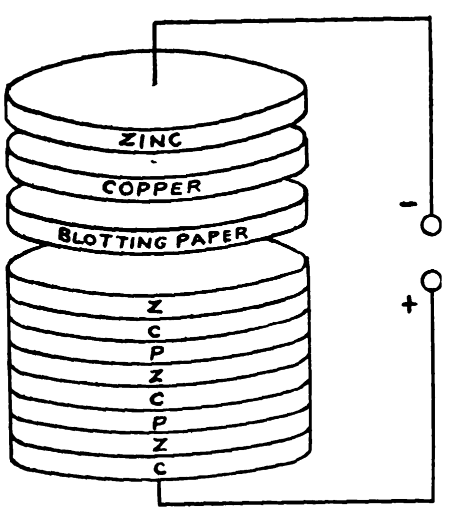
Theories of Galvani and Volta.—Much argument arose in Europe at the time Galvani announced his discovery. He claimed that by experimenting with a pair of frog's' legs he had been able to obtain electricity, which manifested itself in sundry twitches and spasms, and for that reason he heralded his discovery as one of animal electricity. On the other hand, Volta reading of these experiments came to a different conclusion and bitterly contested the hypothesis of Galvani. Thus, it seems, for a long

while opinions were divided. It was believed by the disciples and followers of Volta that the phenomena witnessed by Galvani were due to contact electricity, produced through the contact of two dissimilar metals. And on this basis, a most rational one for the times, it might be said the science of battery construction began.

What is a Battery?—A battery as understood by the scientific world of to-day, is a device by means of which chemical energy is directly transformed into electrical energy. Were it possible to burn coal and thus obtain the electricity without the aid of engine or dynamo the process would be very similar to that taking place in a battery. Here, the fuel is generally a metal and an acid, and from these two is produced the electricity as a full equivalent of the transformation which takes place.

Volta's conclusion that electricity in sufficient quantity can be produced by the contact of dissimilar metals to cause a convulsion in a frog's leg, as for instance, by a steel scalpel coming in contact with a copper plate, and the two metals developing a current which passes through the frog's leg undergoing dissection, was very near to the truth. In fact, to carry out his theories in practice, he built that which is called a voltaic pile.

The Voltaic Pile.—This consists of a disk of zinc and copper resting together, then a disk of blotting paper slightly tinctured with acid, then two more disks,

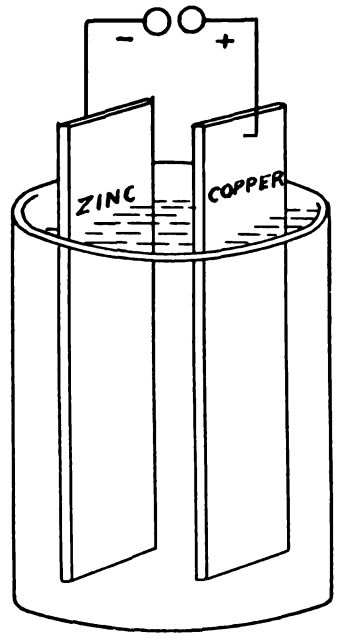


Voltaic Pile.

respectively of zinc and copper, then blotting paper, etc. This arrangement of metal disks is historic and proved a source of the greatest interest to the rising world of experimenters of that time.

As it represents the earliest type of battery of which any records exist, and as from it arose the multitude of diverse forms, including both the dry and the wet battery, with its many modifications, it is evident that an examination of the principles it embodies will prove interesting and instructive.

A Simple Voltaic Cell.—That which is generally called a simple voltaic cell, consists of a jar containing a dilute solu-



Simple Voltaic Battery.

tion of sulphuric acid and two elements. These elements are respectively plates of zinc and copper. On bringing together two wires attached to these plates, a current of electricity will flow.

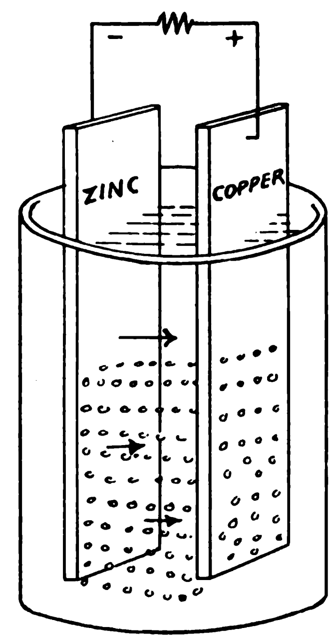
Character of the Plates.—The zinc plate will gradually dissolve away in the solution, and while undergoing this process, it develops electricity. The copper plate seems to serve a different purpose. It is not affected to any extent by the chemical process taking place, but simply serves as a means of transmitting the electricity outside. For this reason the pole of the passive plate is called the positive and the pole of the plate acted upon is called the negative pole. In reality, the plates deserve opposite names, because the plate producing the electricity is the positive plate, though the negative pole, and that to which the current is transmitted, is, more accurately speaking, the negative plate, though the positive pole.

In this respect the voltaic pile composed of alternate disks of copper and zinc, is a simple dry battery in which the dampened paper, slightly acidulated, acts upon the zinc and in producing chemical action develops electricity.

General Effects of Chemical Action.—What is generally understood as chemical action, is a union taking place between dissimilar substances to form a new product. This is familiar to the layman as well as the chemist, but the fact that is not so evident is that whenever chemical action takes place, electricity is developed. In other words, that which is called a battery, is simply a case where chemical action is directly transformed into electricity.

A battery, in this respect, is an ingenious device, invented and improved to carry out this idea as faithfully as possible, and as far as this is accomplished, just so far is the battery an advance over those preceding it. If, on the other hand, the chemical action taking place is not efficiently transformed into the quota of electricity anticipated by theory and calculation, no matter how improved its form may seem, it is not a forward step and would not represent an intelligent advance in the right direction.

Polarization.—A simple voltaic cell will not run well very long. It will gradually fail and its power diminish to a point so low that little or no current is perceptible. A battery of this kind consists of two plates, as stated before—one of zinc and one of copper. These plates rest in an acid solution which attacks the zinc plate. If a jar of this character, containing such elements, is held up to the light the effervescence in the neighborhood of the zinc will be very pronounced. This is due to the sulphuric acid combining with the zinc, thus producing zinc sulphate and hydrogen gas. The solution will also begin to heat up and a perfect stream of hydrogen will



Process by which the Copper is Coated with Hydrogen with the Circuit Closed.

pass across the liquid from the zinc plate and cluster around the copper plate. Hydrogen is one of the lightest and consequently the most buoyant of gases, yet it will not rise from the zinc to the sur-

face directly, but instead moves horizontally to the copper plate. The clustering of these hydrogen bubbles around the copper plate has the effect of weakening the current to such an extent that it is merely necessary for enough of them to gather to completely destroy the value of the cell as a producer of electricity. When this condition has been reached the battery is said to be polarized. Polarization, therefore, is a condition in a cell brought about by chemical and electrical action through which hydrogen gas is deposited upon the copper plate and interferes or prevents the action of the cell, as an electrical generator, from taking place.

Hydrogen on the Copper Plate.—The gas on the copper plate is carried over by the current. The action is called electrolytic, by which is meant that an electric current has the power of carrying over from pole to pole certain constituents that it finds there. In the case of a simple electric cell, the current travels from the zinc through the liquid to the copper plate. The action therefore is exactly similar to electroplating, only instead of zinc being carried over hydrogen is. The copper plate is therefore plated with hydrogen gas, which has two effects upon the action of the cell as an electrical generator. First, the hydrogen acts as a non-conductor, and therefore prevents the electricity from passing into the copper plate; second, the hydrogen has the effect of tending to develop a current in the opposite direction in conjunction with other elements of the cell. These two injurious influences cause the simple voltaic cell to cease its action after a short time has passed.

The ebullition due to intense chemical action will not diminish even though no current flows outside. The process by which current can develop and be used under these circumstances is seriously interfered with, and in consequence methods are employed to destroy the effects of polarization in a cell.

Methods of Depolarization.—Such methods are called methods of depolarization and may be classified under three distinct headings:

First—Depolarization by mechanical means.

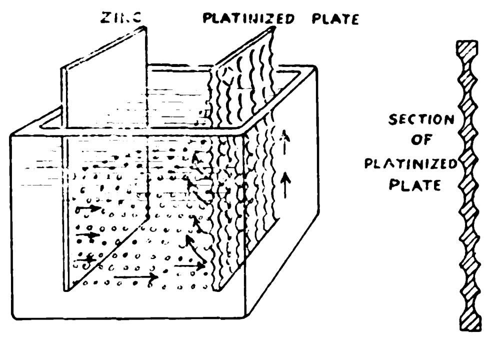
Second—Depolarization by chemical means.

Third—Depolarization by electro-chemical means.

There are no primary batteries in use which do not employ one of these three methods to accomplish the purpose in view, namely, the annihilation of polarization.

Mechanical Method.—This is the simplest method of all to grasp, as it is quite evident that if the liquid in the battery is vigorously stirred the hydrogen bubbles will be dislodged and the gas thus freed will pass to the surface and disappear. The liquid can be kept flowing and will thus perform the same function. Or in many earlier cases of battery invention, air was blown through the liquid and the hydrogen thereby removed.

One of the most interesting cases of the application of this principle is found in the Smee battery. This is a cell greatly in vogue in the past for electroplating, necessitating the use of powerful electric currents.



Smee Battery with Section of Negative Plate Shown and Dissipation of Hydrogen.

The negative plate of this cell was constructed so that it presented a surface of platinum to the liquid, but not a smooth surface. It was rough and prickly and the general appearance of it as shown indicates the difficulty with which hydrogen bubbles could lodge and adhere to the surface. In a cell of this kind the hydrogen passes freely over from the zinc to the platinized copper plate with the result that a continuous stream of hydrogen gas ascends from the negative plate to the surface of the liquid. It is possible, therefore, to sum up the mechanical method of depolarization in the following manner:

First—Depolarization by agitating the liquid.

Second—Depolarization by air blown through.

Third—Depolarization by using rough plates.

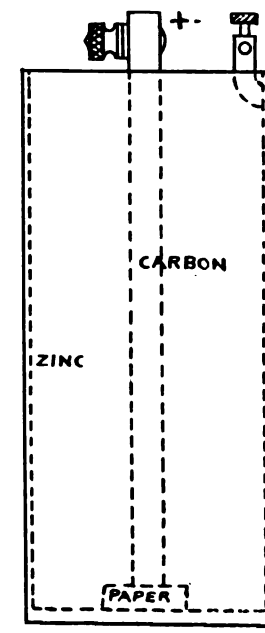
Means are employed nowadays which insure to a large extent the continued action of the battery in cases where such action is expected.

Open and Closed Circuit Batteries.—Polarization has been the means of dividing batteries up into two general classes. They are called

First—Open circuit batteries.

Second—Closed circuit batteries.

In the open circuit batteries it is the intention of the manufacturers to produce a cell which can be used for occasional work without attention. The so-called dry cell is a well known type of this kind. These cells polarize rapidly, but only when kept in continual use. On the

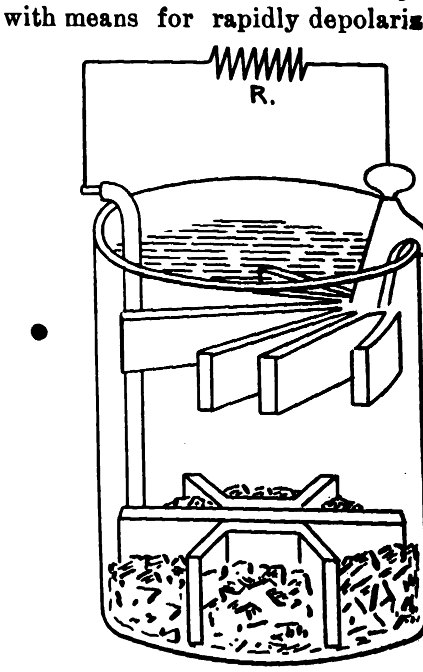


Open Circuit Dry Battery, showing Zinc Envelope Containing Chemicals and Carbon Plate.

other hand, if placed on a shelf or in an out of the way place they require no attention and may be thrown away at the end of a year or more of intermittent use.

Such cells are distinctly open circuit cells, that is to say, they are on open circuit most of the time. If kept on closed circuit for any long period polarization will set in and the cells rapidly become useless unless allowed to recuperate.

An open circuit cell is not provided with means for rapidly depolarising its



Closed Circuit Battery, showing Zinc and Copper Elements.

negative plate. It has not the proper chemicals within to destroy the hydrogen gas rapidly enough to permit an uninterrupted and undiminished flow of current.

In the closed circuit batteries the opposite idea in a sense prevails. The manufacturers of these want to provide a source of electricity which can be permitted to flow for long periods of time without considerable diminution of strength. One of the most familiar batteries of this type is the old gravity battery so much employed on telegraphic lines. It may be connected up to a circuit and will give current for weeks and months at a time. In fact it is so distinct a type of the closed circuit battery that, whereas the dry cell as an open circuit battery must not be on closed circuit for more than a few minutes at the most at a time, the gravity battery must be kept on closed circuit and must not be left on open circuit for more than a short time during its use.

In a dry cell depolarization is slow, but the cell will not eat itself up rapidly when not in use. In the gravity cell depolarization is rapid but the production of current is limited, though continuous, and in this respect the open and closed circuit batteries represent fundamental ideas based upon the method of producing depolarization rapidly and continuously or slowly and occasionally.

THE UNIPOLAR DYNAMO.*

The old problem of the commercial application of unipolar dynamos is discussed in some detail by J. Seidener in a recent number of the "Zeitschrift fur

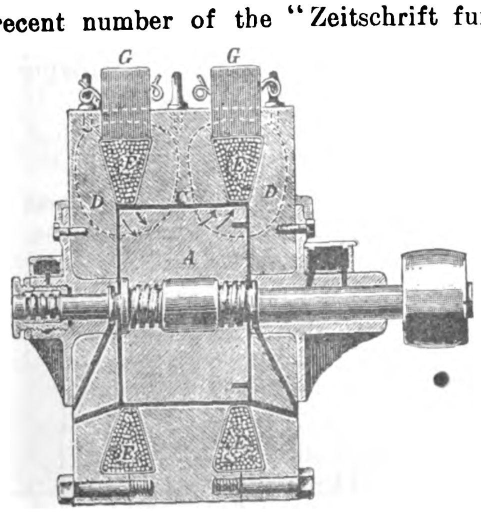


FIG. 1.

Elektrotechnik," more especially with reference to their combination with steam turbines.

The writer points out that the great advantage of these machines is the sparklessness of the current collection, owing to the absence of a commutator, while at the same time one of the chief difficulties experienced with them in practice is connected with this very point of current collection. The high peripheral speeds demanded for the production of ordinary working voltages without an excessive expenditure on material, involve a high friction loss at the collecting brushes, especially if the revolving surface is at all out of truth, as that, naturally, necessitates a high brush pressure in order to prevent vibration.

*From the "Electrical Review," London.

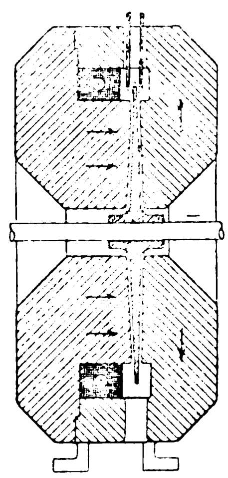


FIG. 2.

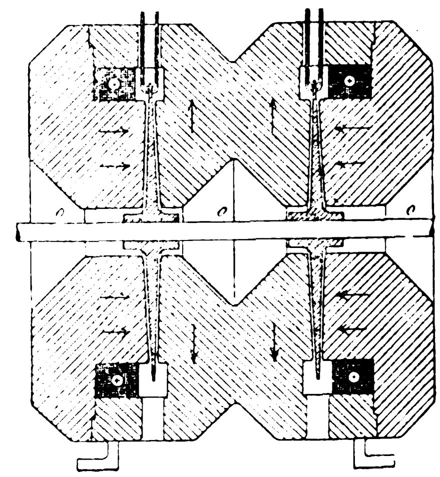


FIG. 3.

same time the weight of material in the disk machine is only half that in the cylinder machine. In order to obtain the same EMF. in both cases, it would be necessary to employ two disk machines in series. Now, in the cylinder machine current collection takes place at two points, both at the maximum peripheral speed. Two disk machines would, together, require four collecting points, of which two would be at the maximum peripheral speed, and two at the minimum peripheral speed, i. e., on the spindle. The two latter collecting points may, however, be eliminated if the two spindles are electrically connected togther, and the direction of excitation of the two field coils is arranged so that the two voltages act in series through the spindle. In this case (shown in Fig. 3) the disk machine has only two collecting points, at the maximum peripheral speed, just as in the case of the cylinder machine, and the complete weight of the material in the two types is the same. Such a two-disk machine is, incidentally, capable of acting as a three-wire dynamo if the middle wire is connected to the spindle. Each side

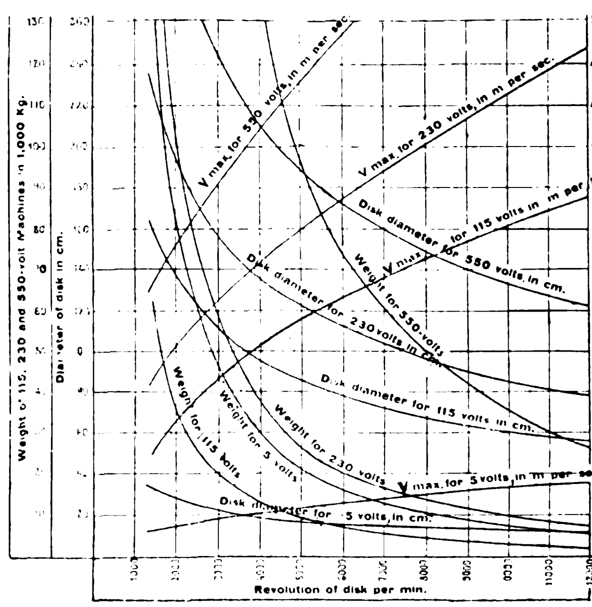


FIG. 4.

On this account, the well-known Forbes unipolar machine (Fig. 1), with a solid cylidrical armature and the current collected at the two ends of the cylindrical surface, is especially difficult to deal with, as the exact balancing of a massive cylinder is almost impossible.

When the armature, however, takes the form of a thin disk (Fig. 2), this difficulty is much more readily overcome, chiefly because a thin disk can be more easily obtained of homogeneous quality throughout than a solid cylinder. Comparing Fig. 2 with Fig. 1, a little consideration will show that for the same number of revolutions per minute and the same external diameter of rotating part, the disk machine will only develop half the EMF. of the cylinder machine, though at the

can have its voltage independently regulated by means of the exciting coil on that side.

It may be pointed out that the dimensions of a unipolar machine depend far more on the voltage required than on the current. The section of material between the points of maximum and minimum potential in the rotating part is, from mechanical and magnetic considerations, already so large, that it makes little difference whether the machine is intended to give 10 amperes or 1,000 amperes. It is clear, on this account, that these machines cannot advantageously be built for small outputs, and are especially suitable for comparatively small voltages and large currents.

Armature reaction, in the ordinary sense of the term, is practically absent, partly because of the low value of the amperes per unit length of armature periphery, and partly because, from the arrangement of the machine, actual armature reaction of the sort that exists in ordinary machines cannot occur.

The collection of the currents, both in the cylinder and in the disk type of machine, is greatly improved if, in place of using the cylindrical outer periphery as the collecting surface, part of the circular end surface is used for this purpose.

Though there is great difficulty in obtaining a truly cylindrical surface (even if the final truing up is carried out at the actual working speed), yet the side faces of a disk made of homogeneous elastic material will approximate more and more to a perfectly flat surface, the higher the speed at which the disk is rotated. With regard to strength the disk of a unipolar machine is even better off than a de Laval turbine wheel, as the former, when sideway collection is employed, need not even be thickened at the outer periphery, and so has no additional weight to carry there.

In the case of small moderate speed machines, the disks would usually be made of material of high electrical conductivity, but bad magnetic quality, such as hard copper, bronze, etc. For large machines and high speed machines generally, the thickness of the disk near the spindle necessitated by mechanical considerations would be so great that the air-gap at the inner portions of the disk would become excessive, and make these inner portions almost valueless as far as the production of EMF. was concerned. If, however, steel or iron is employed as the disk material, the only air-gap in the path of the flux is the sum of the clearances on the two sides of the disk, and this leads to a great saving in the weight of exciting winding required, as compared with the non-magnetic disk type. Since all parts of the disk are at all times in a field of the same density, no hysteresis loss can occur.

There is, however, some danger of a one-sided magnetic drag on the disk, owing to the fact that some magnetic leakage occurs at the outer periphery of the disk, giving a higher flux density on one side of the disk than on the other. This difficulty can be avoided by replacing each of the exciting coils shown in Fig. 3 by two equal coils, placed one on each side of each disk, thus making the arrangement about each disk symmetrical and preventing all peripheral leakage.

The employment of disks of magnetic material and the avoidance of all thickening of the disk at the outer periphery for collecting purposes (by collecting the current from the side faces) enables extremely high speeds to be utilized, and the writer is of opinion that the introduction of machines of this double disk unipolar type is likely to receive a considerable impetus in connection with the manufacture of steam turbines, both on account of the high speeds involved, and also because the manufacture of steam turbines has led to increased experience in the construction of high speed machine parts. In any case, a view of the difficulties met with when constructing ordinary direct current dynamos for coupling to steam turbines, both as regards commutation and the high centrifugal forces involved, a reconsideration of such unipolar machines would seem to be justified.

In order to show the sort of dimensions necessitated with this type of machine, the results of a series of calculations on machines for 5 volts (plating dynamos), 115 and 230 volts (lighting dynamos) and 550 volts (traction dynamos) are shown in Fig. 4. The magnets were in all cases supposed to be of cast-steel, the flux density in the air and in the steel was taken as $B = 15{,}000$ C.G.S. lines per sq. cm., the voltage drop in the disk was neglected, the projecting part of the disk used for current collection was taken as $.05\,D$ where D = outer diameter of disk in cm., the air-gap was assumed to increase directly with the diameter of the disk, so that the section of the exciting coils also increased proportionately to the diameter. The inner diameter of the disk was taken as $.15\,D$, so that the active radial length of pole face $= l = .375\,D$, and the average peripheral speed in meters per second $= v = \dfrac{\pi \times .525\,D \times n}{60}$, where n = number of revolutions per minute.

The EMF. induced in the two disks together is:

$$E = \frac{2\,.\,l\,.\,v\,.\,B}{10^8} = \frac{2 \times .375\,D \times \pi \times .525\,D \times n \times 15{,}000}{60 \times 10^8}$$
$$= 3.08\,D^2.\,n.\,10^{-6},$$
$$\text{or} \qquad D = 570\sqrt{\frac{E}{n}} \text{ in cm.}$$

The weights shown on the curve were obtained by proportion from a single complete working, assuming that the weight varied as the cube of the diameter of the disk—the expression being: Weight in kg $= .0146 \times D^3$.

Machines of this type show a decidedly lower proportion of labor cost to cost of material than in the case of ordinary machines, principally because their massive build necessitates very little machining. The ratio of copper weight to steel weight is also very low. With a 5 mm. air-gap on each side of the disk, and a disk about 100 cm. in diameter, this ratio worked out at only 3 to 3½ per cent.

SOME DIFFICULTIES IN GETTING ON.*

BY J. SWINBURNE.

The chief difficulty in connection with an address is deciding what it is to be about. The obvious thing in an address to students is to give fatherly advice, but fatherly advice is apt to degenerate into platitudes. There is plenty of good advice of a general kind to be had already. There are lots of such books as Foster, Todd, and so on. Smiles has written showing people how to help themselves to the good things of the world, but I have not read any of them. Human nature is marvelously unchangeable, and though the ancients knew very little of the stuff we have to pack our craniums with, they understood much more about human nature; perhaps they had more time to study it than we have. Anyone wanting good advice can find lots of extracts of wisdom in the writings of the Ancient Orientals; much of it is in the form of proverbs and is accessible. Sometimes it degenerates into copybook heading. Ecclesiastes is quite interesting. Then there is lots of human nature in Shakespeare, but we do not read it now. We go and enjoy elaborate scenery and pride ourselves we are appreciating Shakespeare. Rochefoucauld and Chesterfield contain much information, not the less true because it is in a form not flattering to humanity. There has been

*Address delivered to the Students of the British Institution of Electrical Engineers, November 16, 1904.

a large output of books, about how to get on, during the last ten years. I do not know that their authors have yet reached the top of the tree.

None of the Eastern sages give advice that is specially applicable to the electrical engineer wishing to rise in his profession, so I think I may try to say something useful. I therefore propose to talk to you about a few of the difficulties in getting on. I do not propose to deal with my own experience, because that gives any enemy the chance of making the obvious remark, "There would have been no difficulty to anyone else in getting on as far as you have got." Besides one's own experience is of personal interest only; so I will never draw on it except where necessary for an argument or illustration.

The first difficulty is to know what equipment is necessary and how to get it. That is to say, to know what ought to have been learned and how to make up any deficiencies. At once each of us is confronted with the question, "what is going to be my work?" I say "us," because the difficulty in many cases is permanent; one never knows what he will be called upon to tackle in the future. The difficulty is much greater, however, in the case of a young man, because he has probably the vaguest idea of what his life's work will be, and that idea time will show to be quite wrong. Ladies have at different times told me that so-and-so, the new Archbishop of Canterbury, said as a boy, he intended to be an archbishop, and this shows wonderful strength of character, and all that sort of thing. But probably every curate intended to be an archbishop, as there is only one career open, and one top. The lesser peak at York is of the same character. But in engineering it is quite impossible for anyone to start out with a definite career before him. He is like a particular particle setting out across a containing vessel of gas. He cannot careen straight across. He is buffeted about and frequently goes in quite the wrong direction. If he is charged and in a field, he will zigzag across in front of most of his fellows. A man who has made a specialty of electric waves, gets his first appointment as inspector of meters to an electric light company, and so on. A well known engineer remarked to me the other day, that he found his knowledge of differential equations, and his experience in the correct analysis of the rare earths, was of little use in putting in sewage plant; yet he had made lots of use both of his mathematical and chemical analysis in his time. Probably each man should have a general knowledge of applied physics and chemistry and mathematics, and a special knowledge of one or two subjects. The special knowledge may never come in useful; but the chances are that in the blind stumblings we call our careers, a specialty may be very valuable. If you glance round at the work of some of our big men you will be surprised to see how many have made their reputation by doing one small thing, but doing it well. If a man gets to the front in one narrow subject the world credits him with knowledge of all the rest. It is, however, even easier to acquire a large general knowledge than an advanced special knowledge of one narrow subject. The specialty must not be too narrow either. I remember a Scotchman applying for an opening. He had no knowledge of electrical work but thought it was easy to become an electrician. I suggested that he had better stick to his own line, in which he admitted he was really at the top of the tree. He said, unfortunately, eminent as he was in it, there was just then no opening. His specialty was "turneep anawlysis." He could analyze a turnip better than anyone else in the country; but no one wanted any turnips analyzed.

One of the great difficulties is to keep knowledge in a polished state ready for immediate use. In practice it may have to lie idle for long periods and then be wanted very much on short notice. This fact is overlooked by people who suffer from the modern craze for writing about technical education. For instance, we are told that all engineers ought to have the calculus at their finger ends, and so on; but it is forgotten that though an engineer ought to be well up in mathematics, he only makes a calculation requiring higher mathematics once in several years, perhaps; and it is impossible for him to keep his mathematics in working order down to minute details. All he can do is to keep general principles in his mind. Probably the only thing to do is to treat knowledge as a huge district into which one's life is long enough to make some very little roads. From each main road there are branch roads, and from each branch road little paths, and so on to an infinite extent. Many places can be reached by several paths. Each road or path gets obliterated by weeds if it is not constantly trodden. Life is too short to make many roads or paths, and very much too short to keep many of them in order by constant use. The best thing then is to keep one or two main roads clear, and remember where the branch roads and paths are, and go over them again when needed. To go back to plain speaking, the great thing is to master a certain number of broad fundamental principles which will give a starting point for refreshing old knowledge or acquiring new. For instance, in physics, the law of conservation of energy and all that follows from it; the principles of the kinetic theory of gases; the ideas of lines or tubes of force; the principle of the interlinked circuits, and the principle of the growth of entropy in all thermo-dynamic changes. Personally I have always found the backbone of organic chemistry troublesome to remember, chiefly because I very seldom have anything to do with it. A am now making a set of charts showing the derivation of the compounds, so as to get it clear in my mind and to have it as a reference. I do not mean that I am including all the substitution products that amuse the Chemical Society; all that is needed is a skeleton which can be developed in any direction when any particular matter has to be understood.

As to how a man ought to be technically educated; that is not a matter for me to discuss. It is a very large subject. I would only refer to one aspect of it. One of the greatest difficulties in getting on arises from the idea, which is carefully fostered among English science teachers, that there is something degrading in applying science, and that business ability is an inferior quality which is to be despised. No science teacher is so foolish as to tell his pupils in so many words that the object of science is not to be useful; but the whole attitude of science teachers in this country is that of contempt for practice and admiration for unapplied science. All teaching is hopelessly unpractical, and the teaching of science is wholly unpractical. This is not due to a curious perversity among schoolmasters in general or science teachers in particular; it is a perfectly natural and, I believe, quite unavoidable result.

If you imagine a school or college, which somehow came into existence and gave a good education, teaching the things that are useful in a useful way, and imagine that after a time new masters have to be chosen out of the old pupils, who will get the appointments? The old pupils will consist of clever men who absorbed the education in a practical way, and equally clever men who absorbed the information but gave it a less practical turn. It will also consist of less able men of each kind. The ablest practical men will have gone out into the world, doing its work, and so will many of the less able practically minded men. The

able men with a slightly unpractical bent will thus become candidates for the new posts. The next generation of teachers is thus less practical, and the education becomes more and more unpractical as time goes on. There is thus an unavoidable tendency for education to become more and more unpractical. Ordinary school education is entirely and hopelessly useless. This is mainly due to its having come down through the church and to the church still having control of it, but very largely due to this tendency, which is really involved in clerical control indirectly, too. The only possible use of the present day public school and university training is to make more schoolmasters. A man who does well at school and college is fit to be a schoolmaster or clergyman and nothing else. He may do other things in spite of it, especially as his competitors are equally badly off; but that is all that can be said. In science and technical training the same unavoidable evolution towards the unpractical is always going on. It is but human to glorify one's own office. The result is that the attitude of the science teacher in this country is that of a real though unavowed antagonism to the scientific development of the industry of the nation. Science, for which no use has been found, or which is not applied, is called "Pure Science," whereas it is really the raw material and should be called "Raw" or "crude science." There is an assumption of superiority in the term "Pure Science," and generally the term "Science" is appropriated by workers in raw science in much the same way as the term "working man" is appropriated to the exclusion of brain workers. There is supposed to be something noble and superior about "Raw Science," and its study is treated as the unselfish devotion to the interests of man, which is obviously entirely the wrong way round. The so-called "scientific man" thinks that engineers and manufacturers are ignorant and unscientific, and that their practical knowledge is of no account; and that the cure for all industrial evils is more technical education, more universities and more power to the science masters. Though there are in existence a few practical science teachers, they are rare. Perhaps no one would be more surprised than the average science master if you told him he was unpractical, and was, by his attitude and example, hindering science. He does not mean to. He is as keen as possible to do just the reverse, and is generally exceedingly anxious for the spread of science or technology; but, unfortunately he has got a wholly wrong view of the relations of science and business. There is no more baneful influence on the technical advancement of this country than the Royal Society ideal in science.

It is often said that the pursuit of knowledge has a nobility of its own. But what knowledge? You may find out what all the numerals in "Bradshaw" add up to; or who was Napoleon's great aunt; or what Mary Shelley ate; or who really wrote the tune of "God Save the King," or the "Letters of Junius;" or who really started the kinetic theory of gases. In each case you gain knowledge. But you will say "what is the use of such knowledge?" Your question at once commands the answer. No knowledge is worth obtaining for its own or any other sake, unless it is or will probably be useful to man.

I would earnestly urge any of my hearers who has the idea that there is something noble and superior about "Raw Science," or who thinks little of business men, to get rid of all such notions if he hopes ever to get on. If you look round the electrical industry, or round the industries generally, who are at the top? Always the business men. The men at the head of large industries generally know very little science. A man may run a large electrical industry with the most vague ideas as to the true relation of the electrostatic and electromagnetic systems of units; in fact, he may think power, force and energy are very much the same kind of thing if looked at in a broad common-sense way without any scientific prejudice. If he wants good technologists he employs them. If he wants practical men who can take commercial responsibility he pays good salaries, if he wants men full of book knowledge he pays low salaries, but he does not generally want them. Raw scientists, to coin a horrible word for a most estimable class, tell him he knows nothing about science, and therefore does not know how to run a scientific business, and tells him to subscribe to universities, which are so inefficiently worked that they have to beg, like hospitals, and to employ young men from the technical colleges. He either takes no notice or gets annoyed at their superior attitude, and discharges a couple of scientific men and puts their saved wages towards the salary of a new practical chauffeur, and enjoys himself. Yet the science teacher looks down with contempt on the engineer as an ignorant rule-of-thumb inferior person, and the engineer in his turn looks down on the business man as a money-grubbing person with no brains and with no lofty ideals. But this is all topsy-turvy. The business man at the top, the practical engineer in the middle, and the unpractical engineer, or the raw scientist, at the bottom. The business man may have no knowledge of the ways of nature, but he has a knowledge of the ways of man, a knowledge which is infinitely more difficult to acquire and infinitely more difficult to employ well. His brain may be different from that of the scientific man; but there is no reason to suppose that it is less. Its convolutions may be different, but the probability is that they are even more complex than those of the scientific man.

(To be continued.)

IS THE AUTOMATIC TELEPHONE SYSTEM BEST FOR THE TELEPHONE PATRON?*

BY P. KERR HIGGINS, A.M.I.E.E.

I have asked myself this question, because I believe this is after all what is uppermost in the minds of my hearers tonight. The technical side of the question, while probably interesting and instructive, does not really touch the spot.

In order to answer this question it will be necessary for me to review briefly the general features of both systems. When a new or improved system is brought forward the pros and cons are usually from three points of view. (1) Its practicability from an engineering standpoint; (2) its possibility from the financial side, and lastly (3), can subscribers be shown that it is best for them. It is the last question I am called upon to try and solve tonight.

In treating the question it is opportune to state that I am not speaking of a mixed system, such as we have in Los Angeles at present, but a full automatic system such as Los Angeles will have when the transformation of the manual into automatic is complete.

Mixed manual or manual and automatic systems never were altogether satisfactory, being only a temporary expedient necessary while making a change from one system to another. The troubles arising from a mixed manual and automatic are (1), people forget to pull dial down to main in order to get numbers not on automatic and persist in trying to get them automatic, which they cannot do, and no satisfaction being given they conclude it is the fault of the system; (2) the system under these conditions is necessarily complicated and trouble is more

*Paper read before the Engineers and Architects' Association, Los Angeles, Cal.

likely to make itself felt. In answering the question before us we will keep in view certain definite requirements of the average subscriber, that is features which the subscriber usually expects in a first-class telephone system:

(1) Secrecy.
(2) Simplicity of operation.
(3) Correctness of connection with party called.
(4) Speed in answering, disconnecting and making connection.
(5) Information desired.
(6) Possibility of obtaining party called.
(7) Liability for line to be out of repair.

I will now proceed to review the familiar features of each system. In the manual system we have (1) the subscriber's telephone set; (2) the line connecting this telephone with the central station; (3) protection from crosses carrying dangerous currents and from lightning; (4) facilities for balancing up the work of the operators; (5) facilities for changing location of subscribers' lines without changing their advertised number; (6) signaling apparatus for notifying the operator of a call from a sub-station and may consist of either a target, annunciator or lamp; (7) means for operator taking the subscriber's call; (8) means for testing the called line as to whether it is in use or not; (9) means for connecting operator to called line and ringing his bell; (10) means for connecting both parties together; (11) means for signaling operator if connection is unsatisfactory or another is desired; (12) means for taking down connection on signal that parties are through; (13) means for manipulating all this apparatus and accommodations for same; (14) supervision of operators.

SECRECY.

It is a well known fact that few, if any, manual systems now in use permit of absolute secrecy for each and every telephone connection made, while in the automatic this is the strong feature of the system. In the manual system, as is known, it is possible for an operator to listen in on any conversation even although every effort is made by the management to keep them from doing so. It is also equally true that operators can annoy subscribers while in conversation and interrupt their connection, and it is difficult, if not impossible, to locate the blame. In the automatic this is entirely eliminated and there is only the remotest possibility of interference on any connection, and this is always due to trouble in the apparatus, but with everything working smoothly no interruption is possible, which cannot be said of the manual system.

SIMPLICITY OF OPERATION.

In this regard the modern central energy manual system is ahead of the automatic, in that a patron has nothing to do but take down the receiver and wait; the taking down of the receiver is easy but sometimes the wait is so drawn out as to make the simplicity less desirable to the subscriber. It has been said, and said truly, that if we want to make people happy we must keep them occupied, seconds seem like hours when one is in a hurry, and it is my frank opinion that I would rather spend from six to eight seconds turning in my call and obtaining connection with the party I wanted rather than stand idle and wait for an operator to answer my call. I am, therefore, compelled to draw the conclusion that the average subscriber would prefer to make his own call, which does not exceed 10 seconds for the completed connection, than wait for an operator even if she answered in five seconds, which would be good service, as he would then have to give her the number he wanted and frequently have to repeat same if she did not hear well, or he did not speak distinctly. I am willing to admit that the expense of maintaining the automatic sub-station is more for the telephone company, but I am not discussing the question from that standpoint. The liability for trouble is probably greater in the automatic set than in the manual, but not such as to form an important feature in this connection. As to efficiency in talking from the subscriber's standpoint, it is higher in the automatic than in the central energy manual system, provided the telephone company maintains same with proper care.

CORRECTNESS OF CONNECTION CALLED FOR.

It is a fact that in the manual system mistakes are very frequently due to bad articulation on the part of the calling subscriber, defective hearing or carelessness on the part of the operator, etc., whereas in the automatic, if a mistake is made (all apparatus being in good order), it is done by the calling party, and he has no one to blame but himself. It has been said that being human we are prone to err, and if one were to examine the miniature jacks, thousands of which are in front of each operator with very small numbers, we would be surprised that more mistakes are not made. Here the automatic gets in its work, selecting with unerring precision and promptness numbers in a manner simply impossible with human help. In the automatic system each subscriber has an absolute monopoly of his own operator; in other words there is an operator for each subscriber; in the manual there is one operator to from 100 to 140 lines. The automatic apparatus is more or less a duplicate of the manual operator, only the work is done quicker and automatic. There are two movements in the automatic, termed the vertical and the horizontal, and are represented in the manual by the same movements of the operator's arm.

On the vertical side the figures sent in make a corresponding number of breaks in a battery circuit, and the same number lifts the vertical rod one notch for each break, after which it is swung horizontally, only once for each figure turned in, the combination of these two motions in conjunction with a trunking system completing the connection. There is no guess work. The trunking is only brought into play when the system is over 100 lines. There is no doubt whatever in my mind that in this regard the automatic is vastly superior to the manual.

SPEED IN ANSWERING, DISCONNECTING AND MAKING CONNECTIONS.

In the manual system the speed in answering is variable, depending on whether or not the operator is busy, and the humor she is in. In the automatic it is a constant quantity—the apparatus is idle awaiting your pleasure; disconnection of calls is probably one of the weakest points in manual practice, and one of the strongest in automatic. In the former it varies as does the speed in answering a call but in the latter it is done instantly; the act of hanging up the telephone receiver restores all apparatus to normal at once, and you can have another connection immediately; this is not true of the manual. In the making of connections there is certainly no comparison, everything being very much in favor of the automatic as a general rule. I found from a series of tests that I could select, ring and get my party while the operator had only reached the point of getting ready to ring up party called; these tests were made where I could watch the movements of the operator and determine her progress with the call, and was done without her knowledge. I am thoroughly satisfied that in this connection the automatic is much more expert, correct and quicker than the manual ever could be under ordinary conditions.

INFORMATION DESIRED.

In manual practice there is much information given by the operator, which sifted down is really unnecessary. All the information really needed by the subscriber is had from an information desk, specially equipped for this purpose, and such is necessary in automatic practice.

While in the automatic we claim we cut out all operators, we do not change the existing arrangement for special service, which work is done not by operators but by clerks. It is, then, possible to supply all the needed wants of a subscriber in the automatic as in the manual. Indexes are used in manual practice for notifying a patron when a 'phone is (1) out of order, (2) changed his number, (3) ordered his 'phone out, etc. I am sorry to say these facilities are not yet applicable to the automatic, and the only manner known to the writer at present that is really practical is when the patron does not get the party wanted or a busy test (a fluttering sound on the line); then he should call information and find out the reason why he is unable to get his party. This desk should and will be kept advised of all such information, and if not in possession of information desired will at once take steps to find out and advise the patron.

POSSIBILITY OF COMPLETING CONNECTION.

In manual practice the operator rings the called party and if no response is given to the second call she informs the called party that they do not answer. He may request her to ring again, but seldom does, not knowing the full meaning of "they do not answer." If we look back into our past experience as telephone users we will remember distinctly having had our bell rung, but we were busy perhaps in such a way that we could not leave instantly and by the time we reached the 'phone to answer the call central would tell us "not wanted" we would assure her the bell rang, but if we have seen the modern telephone switchboard where any one of say 100 operators could ring our bell, we would appreciate the almost impossibility of "our own operator" not being able to tell who wanted us. In the case of the automatic this also applies, but is the act of the calling subscriber; he may without consulting any one continue to ring the party he wants as long as he pleases and the experience has been that nearly 92 per cent. of all such calls are completed as against 65 per cent. in the manual. In this connection it is also noted that the operator frequently rings the wrong party, and after noticing her mistake would withdraw the plug, causing the same trouble as already explained; this is almost if not entirely eliminated in the automatic.

LIABILITY OF APPARATUS BEING OUT OF ORDER.

The possibility of trouble on automatic apparatus is slightly greater than on the manual, and calls for more expert attention, but the subscriber cares little for this. If the apparatus receives immediate and expert attention, the telephone user will experience no more trouble or annoyance from such than he does in the manual.

PARTY LINES.

It is at present undesirable to give party line service on the automatic, and here in Los Angeles after our experience with party lines and main lines I think the average user will consider this no drawback. When I say undesirable I mean that a party line whereon the bell only rings when party is wanted and not when calling other people on same line is not yet fully developed in the Strowger Automatic, but it is possible to give a non-selective party line service such as the "Sunset Company" (Bell) has been giving, where all the bells on one or both sides of the line ring for all parties, and it is necessary to indicate the station called by a predetermined number of rings.

(To be continued.)

Underwriters' Annual Meeting.

Secretary Dudley Farrand, of the National Electric Light Association, has notified the members with regard to the annual meeting of the Underwriters' National Electric Association to be held in New York City to-day (December 7). A number of interesting changes and revisions of rules as to wiring, fixtures and other matters relative to electric light and power supply, that deeply affect the welfare of the central station industry, are to be considered. The National Electric Light Association, which has always followed insurance questions closely, is taking an active and vigilant interest in all that tends to protection of methods and increase of safety.

Twenty-Eighth Convention of the N. E. L. A.

President Davis, of the National Electric Light Association, recently returned from a trip to Colorado, where he went for the purpose of deciding upon the meeting place of the twenty-eighth convention of the association. After visiting Denver and Colorado Springs, and conferring with a number of Western members, it was decided that the business meetings of the conventions be held in Denver for three days and the delegates then be taken to Colorado Springs for the entertainment portion of the meeting, giving two or three days to sightseeing and social intercourse. The meeting will be known as the Denver-Colorado Springs Convention.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOV 29, 1904.

Electric Railways and Appliances.

775,937. Car Fender. Luther Ridout, Memphis, Tenn. Filed July 21, 1904.

775,993. Guard for Trolleys. Joseph B. Short, Wilkinsburg, Pa. Filed March 1, 1904.

776,064. Trolley. William A. Holland, London, O., assignor of one-half to E. E. Harvey, same place. Filed Dec. 11, 1903.

776,214. Electric Railway Signaling System. Marion A. Born, Lawrenceville, Ga., assignor, by direct and mesne assignments, of part to Early W. Born, Norcross, Ga., Edward W. Vance, Buford, Ga., Milton Hopkins Loudon, Kansas City, Mo., and Emma Byles, Washington, D. C. Filed March 11, 1902.

776,238. Electric Switch and Signal Apparatus. Lawrence Griffith, Yonkers, N. Y. Original application filed Nov. 28, 1903. Divided and this application filed Oct. 18, 1904.

776,303-304. Electric-Car Truck. William Dalton, Schenectady, N.Y., assignor to the American Locomotive Company, New York City. Filed June 11 and Sept. 20, 1904.

776,371. Electrical-Railway System. William J. Alexander, Philadelphia, Pa., assignor of one-fourth to Joseph Simon, same place. Filed May 18, 1904.

Electric Lights and Appliances

776,059. Means for Counteracting Arcs. Rudolf E. Hellmund, New York City. Filed Nov. 27, 1903.

Electrical Machinery and Apparatus

775,933. Electric Switch. Isaac H. Parsons, Leicester, Eng. Filed Feb. 23, 1904.

776,001. Transformer. William L Waters, Milwaukee, Wis., assignor to the National Electric Company, same place. Filed Aug. 18, 1904.

776,027. Frictional Power-Transmission Device. Ivert Larsen and Robert Hardie, Chicago, Ill. Filed Aug. 19, 1903.

776,144. Automatic Electric Regulator. Alexander McGary, Lagrange, Ill. Filed April 20, 1903.

776,220. Controller for Electrical Vehicles. Henry H. Cutler, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, same place. Filed April 15, 1903.

776,223. Means for Controlling the Voltage from Electric Generators. Isidor Deutsch, Montreal, Canada, assignor to the Electric & Train Lighting Syndicate, Ltd., same place. Filed April 30, 1903.

776,288. Power-Transmitting Device. James H. Baker, Saratoga Springs, N. Y., assignor to the Baker & Shevlin Company, same place. Filed March 7, 1904.

Telephones and Telephone Apparatus.

775,921. Telephone-Call Teller. Henry M. Hile, Canton, O. Filed July 15, 1904.

776,067-068. Multiple Switchboard for Telephone Exchanges. Milo G. Kellogg, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Nov. 30, 1891. Renewed Oct. 16, 1899; July 29, 1893. Renewed Oct. 17, 1899.

776,090. Telephone System and Apparatus Therefor. Walter C. Runge, London, Eng. Filed Dec. 9, 1902.

776,290. Device for Connecting and Disconnecting the Talking-Circuits of Telephones. Addington L. Brinckle, Philadelphia, Pa. Filed March 23, 1904.

776,429. Service-Meter for Telephone-Lines. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company. Filed April 9, 1900.

776,435. Telephone-Exchange System. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company. Filed May 24, 1902.

Miscellaneous.

775,986. Insulator. Samuel Oakman, Cheshire, Mass., assignor to Luther A. Wright, Boston, Mass. Filed Nov. 7, 1903.

776,062. Electromedical Apparatus. William Hirschhorn and Fritz Lowenstein, New York City. Filed Nov. 11, 1903.

776,119. Perforator for Telegraphic Transmitting-Tapes. Patrick B. Delany, South Orange, N. J. Original application filed Dec. 15, 1896. Divided and this application filed Aug. 20, 1901.

776,160. Telegraph-Key. Roye M. Wood, Chicago, Ill. Filed May 9, 1904.

776,339. Electrical Cableway-Conveyer. Charles Messick, Jr., Hackensack, N. J. Filed Sept. 7, 1904.

776,374. System of Electrical Distribution. Bion J. Arnold, Chicago, Ill. Filed Dec. 17, 1901. Renewed Jan. 8, 1904.

776,380. Method of Producing Quick Electrical Oscillations of Different Phases. Ferdinand Braun, Strassburg, Germany. Filed July 26, 1904.

776,454. Rheostat. William Christensen, Philadelphia Pa. Filed Aug. 24, 1903.

THE TELEPHONE WORLD.

Pushing Independent Telephone Project.

Residents of Denver, Col., will be able to talk over Independent telephone lines to Kansas City, St. Joseph, Mo.; Topeka, Kan.; Sioux City, Ia.; Salt Lake City, Ogden, San Antonio and Houston, Tex., before the end of another year, is the promise made by H. M. Spere, general manager of the El Paso Telephone Company, with headquarters in Colorado City.

Mr. Spere has been making preliminary arrangements in Denver for the drafting of a bill to be presented to the city council asking for a franchise to operate an Independent telephone company there.

This is to be done shortly after the first of the year, when a petition will be circulated in an endeavor to get 25 per cent. of the voters to sign it, so that the council can pass an ordinance granting the privileges asked for.

It is the present intention of the El Paso Telephone Company to seek franchises in El Paso, Teller, Fremont, Pueblo and Douglas Counties, and in the city and county of Denver. The capital stock is now $500,000, but it is said all the money necessary is behind the enterprise.

The Big Hole telephone line will soon be connected with the Anaconda, Mont., exchange. Alexander Ralston, of Ralston, in the Big Hole Valley, has been perfecting a deal whereby the connection could be made. All the ranches in the valley will have telephones. The line will run from Wisdom through French gulch.

A barb wire telephone line to go out of Benkleman, Neb., will be 12 miles long, and include 15 'phones. The only cost to the subscriber will be that of the instrument that he uses and the trouble of making the connection, and the cost of maintenance is expected to amount to $4 year. There is not an insulator on the fence, yet messages are carried perfectly the whole distance.

At the annual meeting of the stockholders of the Orange Telephone Company, held in Fredericksburg, Va., a dividend of 6 per cent. was declared on the stock. Hon. George S. Shackleford was re-elected president; Col. C. C. Tallaferro, vice-president; Dr. W. J. Crittenden, general manager, and Capt. W. F. Coates, secretary and treasurer.

J. C. Duncan, president and general manager of the People's Telephone Company of Knoxville, Tenn., says: "As soon as our telephone list reaches 3,000 we are going to the automatic system of telephoning. Our list is now 1,800."

A telephone line is being considered between Chase City and Red Oak, in Charlotte County, Va., connecting with Drake's Branch, Charlotte Courthouse and Lynchburg. Heretofore, the connections have been with points south and east only.

Manager George C. French, of the Wisconsin Telephone Company, says that during the last two years that company has installed between 4,000 and 5,000 new telephones in Milwaukee.

Bird Island, Minn., is talking of an Independent telephone company.

Various Telephone Lines Consolidate.

Recent news from Clifton, Tenn., states that papers have been filed incorporating the Consolidated Telephone Company. The incorporators are: H. B. Stubblefield, of Nashville; W. N. Sloan, of Linden; J. K. and J. F. Barlow, of Savannah, and T. S. Hughes, of Clifton, and the articles of incorporation fix the capital stock of the company at $50,000. These parties own the various private telephone lines operating in Wayne, Hardin, Perry, Decatur and McNairy Counties. and have by this act put them all under the control of one company, with a total of about 700 miles of line now in operation. Arrangements have been made to connect with the Cumberland system, both at Corinth and Waverly, and all exchanges now in operation maintained. The system will at once be thoroughly overhauled.

Will Try Telephone Slot Machine.

The Pacific States Telephone & Telegraph Company has decided to make a trial test with six public telephones in San Francisco, Cal., with a new patent. The invention returns the nickel to the depositor should he be unable to secure the connection required.

When the nickel is dropped it only goes half way down the box, and should the line be busy, or the telephone out of order, the telephone operator, by pressing a button, releases the nickel, and the coin drops out of the box.

The question of increasing the capital stock of the Pennsylvania Telephone Company will be presented to the stockholders of the company at the annual meeting to be held at the general offices of the company in Harrisburg January 25. It is proposed to increase the stock of the company from $3,000,000 to $5,000,000. The stockholders will also elect directors for the ensuing year.

A company of Rock Springs capitalists has arranged to build a telephone line from Rock Springs to Lander, Wyo. The Lander authorities have granted the company a franchise and work on the new line is to be commenced at once. When completed to Lander, from Rock Springs, the line will probably be extended to the towns in that vicinity.

Plans are being prepared for a seven-story building at the northwest corner of 10th and Locust streets, St. Louis, Mo., to be erected by Adolphus Busch for the Kinloch Telephone Company. The structure will be a first-class fireproof building, arranged especially to meet the requirements of the company.

The Independent Consolidated Telephone Company of Milwaukee, capitalized at $500,000, has been incorporated by A. L. Hutchinson, Edward I. Fairchild and Harry S. Hadfield, to operate telephone lines anywhere in Wisconsin.

The Delaware and Atlantic Telephone & Telegraph Company, of Camden, N. J., has increased its capital from $100,000 to $400,000.

J. F. Fuller is installing a telephone plant in Eustis, Fla.

Telephone Magnates Discuss Improvements.

Representatives of Independent toll lines, doing business together in Western Missouri, held their November conference at St. Joseph, Mo.

Those present were J. E. Zeluff, of Kansas City, general superintendent of the Home Telephone Company and associated toll companies; C. J. Myers, of Kansas City, auditor of the Home Telephone Company; W. A. Rankin, of the Independent system of Tarkio; Ed Ralston and Harry Todd, of the Independent system of Maryville; Dr. J. J. Newell and E. W. Hooper, of the Citizens' Company, St. Joseph. The meeting was for the purpose of discussing improvements.

"The Independent telephone toll systems, which have their main points in Western Missouri, are spreading rapidly," said one who was present. "There is the new toll line between Kansas City and St. Joseph, the Western Independent's lines now building into the Indian Territory by way of Eastern Kansas, and another line of the same company into Little Rock, Ark., by way of South Central Missouri.

"Besides these are lines through Kansas, now in operation or projected. St. Joseph itself is making a notable extension in the Funston line to Cameron and Chillicothe and thence north into Iowa. All this has been accomplished practically within the last year."

The Chicago, Rock Island & Pacific is placing a telephone line between Denver and Colorado Springs, Col., and Goodland, Kan., the latter being the end of the division, for the handling of trains and also for the transaction of railroad business.

The Honesdale, Pa., Telephone Company (Independent) has completed the construction of its line, and is now giving its patrons service to all points reached by the lines of the Consolidated Telephone Companies of Pennsylvania from Carbondale to Philadelphia and points in Maryland.

The board of aldermen of Greensboro, N. C., recently adopted the underground wire ordinace, after striking out the word telegraph, and as it now stands all telephone wires must be put underground in the business section.

The Independent telephone companies of Richland, Jasper, Crawford and Lawrence Counties, Ill., have consolidated with a capitalization of $100,000.

The Blair, Neb., Telephone Company, a mutual concern, has just completed a new line west of Blair.

Telephone Incorporations.

The Farmers' Exchange Telephone Company, Bluffs, Ill. Capital stock, $10,000. Incorporators: Henry Knoepple, G. W. Vangundy and Henry Finnigsmeier.

The Auburn Telephone Company, Auburn, Ill. Capital stock, $35,000. Incorporators: B. H. Ramsey, E. R. Conklin and F. W. Kelly.

The Lone Rock Telephone Company, Lone Rock, Wis. Capital stock, $1,500. Incorporators: Andrew Harter, George Jamieson and H. Brace.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Athena, Ore.—The council has decided this city shall be lighted for a period of one year with eight 1,000 cp. arc lights. The Preston-Patton Milling Company furnishes the lights for $65 a month.

Cleveland, O.—The Cuyahoga Light & Power Company has been incorporated with a capital of $25,000 by A. Lewinthal, E. Umbstaetter and C. L. Denton. It has applied to the city council for a franchise.

Columbus, O.—Adjutant General Critchfule will seek the assistance of the State Emergency Board to secure enough money with which to install an electric light plant for the State House, or will ask the Legislature next year for an appropriation for the same.

Edgar, Neb.—The city council has granted a franchise to Keefe & Larkin for lighting the city by electricity. They will erect a plant at once.

El Paso, Tex.—The El Paso Gas & Electric Company has been incorporated with a capital of $500,000, by Barrett Ridgely, of Washington, D. C., George Goodnow, of Waukegan, Ill., and others.

Farmville, Va.—This city contemplates expending $15,000 in improving the electric light plant. Mr. Duvall is chairman of committee.

Fitzgerald, Ga.—This city contemplates issuing $25,000 of bonds for the construction of a sewerage system, and $15,000 for extending the electric light and waterworks.

Georgetown, S. C.—The Georgetown Electric Company has been reorganized with H. C. Case, of Philadelphia, Pa., as president. Improvements will be made to the plant.

Glasgow, Mo.—A franchise has been granted for a new electric lighing system here, and work will soon begin.

Joplin, Mo.—The municipal electric light plant and the headquarters occupied by the Joplin Fire Company were recently destroyed by fire. The loss, exceeding $60,000, falls upon the city.

La Follette, Tenn.—This city will immediately put in operation a $150,000 to a $200,000 water plant, and also an electric light plant in order to supply the increasing business.

Lake Providence, La.—The city council has contracted for the erection of a municipal electric light and water plant to cost $37,000.

Martin, Tenn.—There is a strong likelihood that the city officials will at an early date put in a new dynamo and engine at the water and light plant to supply the town with a day current.

Peachtree, Ga.—The Peachtree Lighting Company has been organized by Arnold Broyles, Martin Amorous and Edward Brown with $5 000 capital to establish an electric light plant.

Philomath, ,Ore.—All arrangements have been completed for the installation of an electric light system here.

Red Lion, Pa.—A plan to consolidate this town, Dallastown, Yoe and Windsorville into one circuit for the purpose of lighting the four towns from the electric plant in this place is on foot.

Sioux City, Ia.—Edward Tilden and Samuel McRoberts, of Chicago, are having plans prepared for an electric lighting, power and heating plant which they will install.

St. Elmo, Tenn.—According to statements made by the members of the St. Elmo Business League, the suburbs of this city will have electric lights in the near future.

St. John, N. B.—The council of Wolfville has under consideration the matter of erecting an electric light plant in addition to the one already in operation.

Tama, Ia.—A site for city waterworks and electric light plant has been purchased.

Wellsville, O.—Rumors of a new electric lighting plant for this city have been heard for some time, and recently it was learned that local capital has been interested in a scheme to equip and operate a new plant.

Yankton, S. D.—The Yankton Improvement Company, capitalized at $100,000, with Isaac Piles, William S. Stockwell and Sanford G. Donaldson as incorporators, plan to ask the city council for a franchise to build and operate an electric light and gas plant.

STREET RAILWAYS.

Algiers, La.—The franchise to build an electric car line in this place has been sold by the comptroller to Leigh Carroll and Lynn M. Dinkins.

Bluffton, Ind.—The Interstate Traction Company has filed articles of incorporation with the Secretary of State. Its capital stock is placed at $150,000, and most of the incorporators are residents of this city. It was stated in the articles that the road is to be constructed from Marion, Grant County, in a direct line to Lima, O., a distance of about 90 miles. The directors of the company, are John C. Curtis, of Portland; John H. Painter, Fred M. Caldwell, Frank M. Caldwell, E. L. Murray, John S. Postal, A. C. King, A. L. Sharpe and Cuno Kibele, all of Bluffton.

Catskill, N. Y.—Surveyors have begun to lay out the proposed new trolley line from Oneonta to this place.

Des Moines, Ia.—It is almost a certainty that an interurban electric road will be built from here to Woodward. The cost is estimated at $500,000.

Everett, Wash.—The county commissioners have granted a franchise to W. M. Snyder and J. W. Hall, of Snohomish, for the construction of an electric road from Monroe through the Sultan basin to the 45 mine.

Indianapolis, Ind.—The Indianapolis, New Castle & Toledo Electric Railway Company, capitalized at $3,500,000, has been incorporated by D. N. Parry, W. E. Stevenson, Eli Marvin and others.

Jackson, Miss.—The chances are very good for the building of an interurban trolley line between this city and Vicksburg.

Kalispell, Mont.—Farmers have organized the Flathead Valley Railroad Company of this city, which will build electric lines radiating from here to all parts of the valley. Much of the valley now without transportation facilities will be reached. The lines will connect with the Great Northern on the north, and Flathead Lake on the south.

Marshall, Mich.—Joseph J. Leavy, landlord of the Washington Hotel, is projecting an electric railroad from here to Coldwater via Lyon Lake and Tekonsha.

Morristown, Tenn.—Capitalists from the North are said to be considering the construction of a trolley system on the streets in this city.

Phillipsburg, N. J.—It is reported that Thomas Hay, the transit road magnate and contractor, is contemplating a road from Clinton to Frenchtown at a cost of $150,000.

St. Joseph, Mo.—The promoters of the St. Joseph, Stanberry & Northern Electric Railway Company have submitted a proposition to the citizens of Fillmore, agreeing to run through that town provided $7,500 worth of bonds are subscribed for.

Van Wert, O.—This town is the objective point of an electric line projected in this State, and designed to reach the Ohio oil field. It is backed by men who have other lines in successful operation.

Vinton, Ia.—An electric line has been projected from here to Belle Plaine.

POWER PLANTS.

Charleston, S. C.—The Broad River Light & Power Company, incorporated with a capital of $1,000,000, will build a power plant to supply electricity to the cotton mills of Spartanburg and Union Counties. P. J. Balaguer is president.

Guadalajara, Mex.—The Mexican Government has granted a concession to the Villanueva Company to establish an electric power plant on the San Geronimo River, in this city. The terms of the concession require that the surveys for the proposed plant shall be commenced within six months and that construction must be commenced within two years. The whole plant must be completed within seven years.

Vicksburg, Miss.—Reports state that the Vicksburg Water Company will install a 300 hp. electric supply plant.

BIDS WANTED.

Cleveland, O.—Sealed proposals will be received by the board of trustees of the Cleveland State Hospital until 12 o'clock noon, December 20, for the furnishing and installing of one 175 hp. engine, one 100 kw. generator and one 5-panel switchboard in the power house at the Cleveland State Hospital, according to the specifications, bills and descriptions which are on file at the office of the superintendent of the Cleveland State Hospital, and Frank L. Packard, architect, Columbus, O., and open to public inspection on all working days until date of letting. Proposals to be made out on blanks furnished by the superintendent or the architect, and are to be addressed to Dr. A. B. Howard, secretary of the board of trustees of the Cleveland State Hospital, Cleveland, O.

Columbus, Ga.—F. H. Lummus Sons Company of this city wants prices on dynamo of sufficient capacity to handle 250 incandescent lights and also generate 25 additional horse power.

Fort Leavenworth, Kan.—Sealed proposals in triplicate will be received at the office of the Constructing Quartermaster until 11 A.M. December 20, for extending the electric lighting system here. Address Major D. E. McCarthy, Quartermaster,

Texarkana, Ark.—The Southern Commission Company of this city wants prices on 10 or 15 hp. electric motors.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 14¾@15c.; Lake 14⅞@15⅛c.; casting, 14½@14¾c.

The Interborough Telegraph & Telephone Company of New York was incorporated in Albany on Monday with a capital of $100,000.

The trustees of the Massachusetts Electric Companies formally voted to pass the semi-~~annual~~ dividend of 2 per cent. on the preferred stock.

Rumors of a settlement of the Philadelphia Electric-Keystone Telephone trouble boomed the securities of the former in Philadelphia on Monday.

It is authoritatively admitted that the New Brunswick (N. J.) Gas Company will be bought by the Public Service Corporation within a few days.

Rumors that the Rothschilds will be parties to a combination of traction properties in the Borough of Manhattan are still current despite official denials.

The Chicago City Railway Company has declared the regular quarterly dividend of 2½ per cent., payable December 30. Books close December 12 and reopen December 19.

The City Railway Company of Wheeling, W. Va., proposes to increase its capital stock and to authorize the issue of $1,000,000 bonds for construction and equipment.

The annual meeting of the Boston Suburban Electric Companies will be held Thursday, December 8, at 10:30 A.M., for the purpose of electing five trustees to serve for three years.

At the annual meeting on Monday of the stockholders of the Twenty-eighth and Twenty-ninth Street Railway Company of New York the retiring board of directors was re-elected.

The directors of the Manhattan Railway Company of this city have declared a regular quarterly dividend of 1½ per cent. and an extra dividend of ¾ of 1 per cent. for nine months ending December 31, 1904.

The Boston brokerage firm of N. W. Harris & Co., in conjunction with the Bank of Montreal, purchased $2,000,000 worth of the 5 per cent. gold mortgage sinking fund bonds of the Winnipeg Electric Railway.

The Atlantic City & Suburban Traction Company will extend its lines to make a through connection from Atlantic City to Philadelphia. Through trolleys at 50 miles an hour will probably be running in less than two months.

A dispatch from Chicago says: "A complete restitution of property, alleged to have been taken from stockholders of the West and North Chicago Railroad Companies by the illegal financial methods of Charles T. Yerkes, is asked in the United States Circuit Court by bills filed last Thursday and 'suppressed for service.'"

The Westinghouse Electric & Manufacturing Company has declared the regular quarterly dividends of 2½ per cent. each on its preferred, assenting and non-assenting stocks, payable January 10. Books close December 28 and reopen January 11.

A plan to substitute the overhead trolley for the cable system now in use on lines of the Chicago Union Traction Company, through an order issued by Judge Grosscup, in the United States Circuit Court, for "improvements," is said to be back of the petition of the receivers of the company for permission to issue certificates amounting to $2,400,000 or more. Judge Grosscup has set December 15 as the date for hearing arguments on the petition.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Dec. 5.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	167⅞
Metropolitan Street Railway	123¾
Metropolitan Securities	82
Ninth Avenue	197
Third Avenue	132
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	67½
Public Service Corporation (New Jersey)	110
Philadelphia.	
Consolidated Traction of New Jersey	77½
Philadelphia Traction	98
Union Traction	59⅛
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	15
do. do. do. pref.	62¾
West End Street, com	95
do. do. do. pref.	112
Chicago.	
City Railway	186
North Chicago	76⅛
Union Traction, com	12½
do. do. pref.	43
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	19
do. pref.	69⅞
Electric Boat, com	40
do. do. pref.	68
Electric Lead Reduction	½
Electric Vehicle, com	17
do. do. pref.	23
Westinghouse, com	182½
do. pref.	197
General Electric	190½
Boston.	
Edison Electric Illuminating	253
General Electric	188
Westinghouse Electric & Mfg., com	93
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	45
do. do. pref.	110
Philadelphia.	
Electric Company of America	10½
Electric Storage Battery, com	82¼
do. do. do. pref.	82¼
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	148
Western Telephone Company	20
New England Telephone Company	140
New York.	
American Telegraph & Cable Company	93½
Commercial Cable Company	210¼
Mexican Telephone Company	2¼
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92½
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	48
Consolidated Car Heating	64
Standard Underground Cable	200

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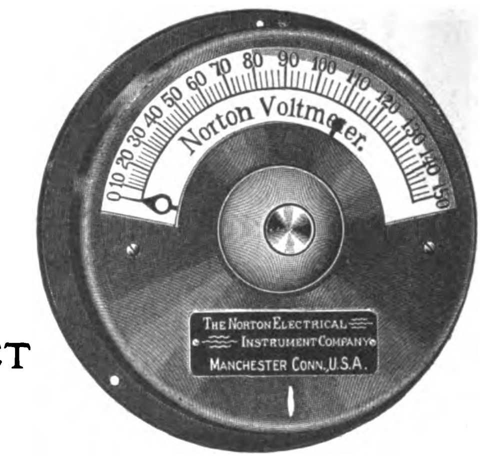

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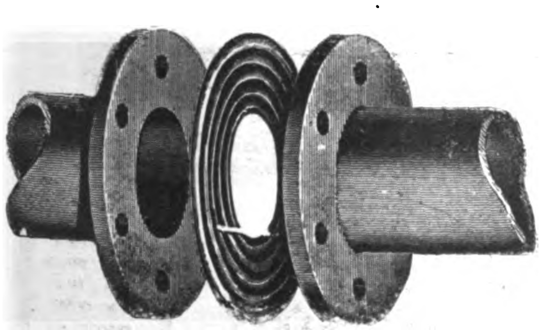

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CONTENTS.

EDITORIAL NOTES.

Position of the Copper Market.

Notwithstanding the raid on the copper stocks, the price of the metal remains steady. There is a fair demand from consumers, but this is probably instigated from a desire to test the market rather than from any buying motive. We are told that the consumption of copper is seriously hampered when the price of the metal goes above 15 cents and we are also told that the demand has steadily exceeded the supply for the past two months and therefore more or less uncertainty will prevail until an equilibrium is established on a sound basis.

A prominent manufacturer, and one who uses large quantities of the metal every year, said Friday: "If there is any copper in the market I do not know where it is. For the past six months I have been attempting to accumulate a stock to last me through the winter months, but I have not been successful. I am buying now for present needs, and am hesitating on several contracts because I am not sure of my stock. If the machinery business keeps its present prosperity, and I see no reason why it should not, there will be an even greater demand for the metal next year than there was this. The electrical equipment, with which many of the railways are equipping, and the general additions to the trade are bound in the nature of things to affect the market for the better. The lake supplies, too, are practically all exhausted and I expect to see an advance in the price."

One of the largest lake shippers of the metal, when asked what he thought of the chance for the market holding its own, said: "From my own personal knowledge there is mighty little ingot at any of the lake mines. What the situation is elsewhere I am unable to say, but I have heard that there is no surplus beyond enough to keep even with call demands anywhere, Of course, we can tell approximately what the situation is by the call we have for our product, and it has been a long time since there has been any such active inquiry for immediate delivery of the metal. As to the present price I think it is conservative according to the market demand. It will surprise me very much if there is not an increase before a month is over, and I believe it will reach 16 cents or better before lake navigation opens in the spring.

* * *

Is This a Bell Move?

A well-known financial paper states that an effort is being made to consolidate all the Independent telephone manufacturing concerns throughout the country into one gigantic telephone trust, which it is proposed to capitalize at $700,000,000.

While the syndicate is said to be composed of Eastern bankers, it is believed among the Independent people that Bell interests are behind the movement. The latter theory, according to a well-known Independent manufacturer, is based on the fact that a similar attempt to eliminate competition was made several years ago, when the Bell interests absorbed numerous Independent telephone manufacturing concerns. This plan failed, however, for as long as there were Independent telephone manufacturers in the field, it was conceded there would be Independent operators.

Hence the only plan by which competition could successfully be eliminated was by consolidating the various Independent manufacturing plants of the country, thereby cutting off the source of supply for the Independent operators.

There is no doubt but what the Inde-

pendent telephone companies have for years been a thorn in the side of the monopoly, and every other means having failed it would not be surprising if those behind the Bell interests were adopting this means of driving them out of business.

It therefore behooves the Independent manufacturers to make sure what they are doing before giving options on their plants.

* * *

The Distribution of Electricity. The London Institution of Civil Engineers, at its meetings of November 22 and 29, gave itself up to consideration of an exhaustive and valuable paper on "Distribution of Electrical Energy," which was read by Mr. J. F. C. Snell, who for some years past has been city electrical engineer at Sunderland, where he has designed and developed a large system of electric lighting and power plant, and electric trolley lines, low pressure direct and high pressure alternating, both forming part of his schemes. Some notes on the early electric lighting development, and references to legislative obstructions to progress were but preliminaries leading on to the more serious electrical engineering details of his wide subject. The systems of electrical distribution at present in vogue were enumerated, and in the course of his criticisms thereon, Mr. Snell set aside the single-phase system as being inapplicable for general supply, and along with it he also placed the direct current high tension system. In his opinion the distributing systems which will be adopted in the future will be: (a) direct current, two or three-wire, for small districts; (b) single phase high tension for railways; (c) two-phase high tension generation and low-tension distribution, for existing single-phase systems of general supply; (d) three-phase high tension generation and direct-current low tension distribution, for existing direct-current systems in large districts, and for railways of short length; (e) three-phase high tension generation and low-tension three-phase or six-phase distribution, for entirely new and large districts. Mr. Snell endeavored, by means of diagrams, to demonstrate the economical radii of supply by direct current at 500 volts for different loads transmitted, and by the high tension sub-station method, and he showed the high-tension method to be more economical above the following distances; 250 kw.—1.6 miles is the economical radius; for 500 kw.—1.25 miles; and for 1,000 kw.—1.06 miles. He holds, as many other leading authorities also agree, that sub-station storage batteries will have a larger place in electrical distribution work in the near future. The most economical limit of pressure for high-tension supply by underground cables was set down as 6,600 volts for English systems; 20,000 volts was suggested for overhead high-tension transmission. The relative merits of the various systems of distributing energy at low pressure, and their respective capital costs were discussed. Electric tramway and railway distribution systems also came in for attention and the opinion was expressed that for short-distance railways a modification of the present third-rail system will remain; but for long-distance lines the improved methods of applying and controlling single-phase currents will be adopted.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

If the Corporation Counsel decides that New York City has the right to build its own electric lighting plant without going to the Legislature Mayor McClellan said on Monday that he would move at once that the Board of Estimate take the matter up and build such a plant. In that case he will not wait for action at Albany.

The next annual convention of the Northwestern Electrical Association will be held in Milwaukee, Wis., commencing on Wednesday, January 18, 1905.

Mr. George Johnson, statistician of the Dominion of Canada, says the amount of water power used for electrical production throughout the world at present is over 2,000,000 hp. The United States figures are 527,467 and Canada's 228,225.

We are informed by Mr. Henry L. Doherty that, as chairman of the general committee on arrangements for the 1905 convention of the National Electric Light Association, he has appointed Mr. John Craig Hammond, chairman of the advertising committee.

A message by wireless telegraphy has been transmitted from the Marconi Company's station at Poldhu to a station belonging to the Italian Government at Ancona, says the London "Electrical Engineer." It was addressed to Admiral Mirabello, Italian Minister of Marine, who has taken a great interest in wireless telegraphy. The station at Ancona is a small one, and was not originally intended for long-distance work. The mileage between Poldhu and Ancona is about 1,000, and almost entirely over land, and in order to reach their destination the waves had to pass over nearly the whole of France and a considerable portion of Italy, including the highest mountains of the Alps.

The trial locomotive built by the American Locomotive and General Electric Companies for the New York Central showed a speed of 60 miles an hour, with eight loaded cars on snow-covered tracks.

It appears from a Berlin dispatch that the project which had been laid before the Prussian Minister of Public Works for constructing a high speed electric line between Berlin and Hamburg is not considered as sufficiently practical in the present state of experience. The authorities do not wish to allow such a road to be built without making a further series of trials on a smaller scale. Accordingly it is proposed to carry on a new set of experiments on the Berlin-Zossen line. It is expected that on the forthcoming trials a speed of 150 miles an hour will be attained.

According to an English paper, M. Andre Gambin, a Paris inventor, claims that a boat which he has patented, but not yet built, will travel at a speed of 500 knots an hour. M. Gambin appropriately calls his invention the "typhoonoid," and states that the time is not far distant when people will be able to breakfast in London and dine in New York. By means of a water-sucking cone placed in front of the ship a vacuum is created, and the vessel is drawn forward by pneumatic suction. "The principle is workable, and the ship would go," declared Sir Hiram Maxim to a representative of the press, "but if it went more than five miles an hour I should be surprised."

The municipality of Buenos Ayres, Brazil, is seriously considering a proposition to establish an electric light and power plant of its own. The plan proposed is that a company shall be organized with a capital of $18,000,000 (gold) to install a municipal power house to supply light and power for all kinds of industries, exclusive privileges as to the laying of mains, etc., to be granted. By a system of amortization, which would allow the company 5½ per cent. upon its capital, it is figured that the plant would become the property of the municipality after a certain number of years.

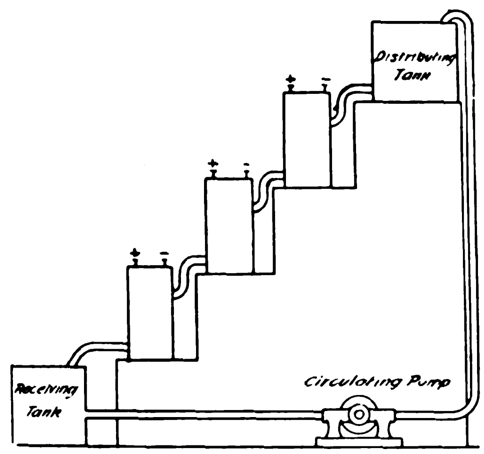
Rochester, N. Y., may adopt the plan of thawing out water hydrants by electricity, as the use of steam in thawing out street hydrants is likely to be injurious to the valves of the hydrants.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

BATTERIES.

Batteries in France.—The greatest activity in battery invention took place in France thirty or forty years ago. In one of the principal squares of Paris electric lamps were set up, and the current supplied to them was obtained from powerful batteries. One of the famous equipments installed was called the cascade battery, which consisted of tier upon tier of cells arranged on a pyramidal series of platforms. The liquid was pumped from a receiving tank at the bottom to the upper cells and from them it descended through a series of pipes to the tank below, thus passing through all cells in succession. The liquid in this system was in a constant state of motion and thereby embraced the idea represented by the expression "a mechanical method of depolarization."



BATTERIES WITH FLUID CIRCULATING FREELY.

In some cases part of the current was diverted through a motor, which, by running a fan with the proper connections, blew air through the liquid of the cells. In other cases the liquid was stirred and this effectually dislodged the hydrogen bubbles.

All the methods outlined produced an agitation in the liquid which caused depolarization; but by far the most important of the three classified means of producing depolarization is the "chemical method."

Chemical Method of Depolarization.—Hydrogen is a gas possessing a great affinity for oxygen. The use of a chemical mixed with the solution, the said chemical possessing a great deal of oxygen, would be effective in combining with the hydrogen, and thus free the cell from the injurious effects of polarization.

The Bichromate of Potash Battery.—A chemical in common use for this purpose is called bichromate of potash. This crystal possesses a great deal of oxygen bound up with the other elements which constitute it. In consequence of this, when a dilute solution of sulphuric acid dissolves crystals of bichromate of potash, the new solution possesses hydrogen-absorbing properties which are used directly in the construction of what is called a bichromate of potash battery.

When the acid solution attacks the zinc, hydrogen gas in very small bubbles is released and carried over towards the other plate, consisting in this case of carbon. It is rapidly taken up by the bichromate in solution, the oxygen combining with the hydrogen and thus permitting the cell to continue to develop a strong current. If the chemical activity between the zinc and the acid is too intense, gas will be released more rapidly than the oxygen in the bichromate can absorb it. In this case, a gradual polarization would ensue and the battery weaken. A battery will polarize, therefore, in spite of the chemical method of depolarization if sufficient depolarizing material is not employed.

What Constitutes an Open Circuit Cell.—In the so-called open circuit cell depolarization is not rapidly carried on. The depolarizing material, such as that used in dry cells, is dioxide of manganese, which simply represents a chemical containing enough oxygen to slowly absorb or combine with hydrogen.

When a dry cell is in use, the salammoniac in contact with the zinc shell of the battery releases hydrogen gas. This gas attempts to pass through the cell to the carbon pole. Before reaching it, however, the dioxide must be traversed. Here the hydrogen is assimilated and the carbon freed from the effects of polarization.

The dioxide cannot absorb the hydrogen very rapidly. For this reason a dry cell will quickly polarize if used continuously. Were it constructed, however, with a great deal of the depolarizing material arranged around and in contact with the negative plate, it is very likely that the cell would be able to operate continously while giving a comparatively powerful current. This would mean a bulky cell and an expensive one as well. The salammoniac solution which acts upon the zinc merely dampens the pulp or packing which is employed in contact with the zinc. A dry cell is therefore a damp cell inside though sealed on top to prevent evaporation.

A cell which polarizes quickly is merely a cell whose constituents combine with the hydrogen slowly. On the other hand, a cell which can remain on closed circuit a long time is one which absorbs the hydrogen quickly. This distinction is very important and shows that the classification on this basis is the only practical one to make with reference to the utility of the cell.

Mixed Types of Cells.—Cells have been constructed which possess the qualifications that entitle them to be used for both purposes. A cell of this description also makes use of bichromate of potash and a dilute solution of sulphuric acid. As a general rule the water is acidulated until a 10 per cent. solution is made—ten parts water and one part acid. In the simple form of the bichromate battery it is the custom to saturate the solution with bichromate crystals. To accomplish this, warm water is employed in which enough crystals are dissolved and then the acid is added.

Mixing Acid and Water.—A rule which must never be broken is that the the acid must be added to the water, *never the water to the acid.* If this rule is not observed serious injury may result to the experimenter. The jar will crack through the intense heat and the acid will spatter around. If it gets into the eyes or on the hands or clothes an alkaline solution must be applied at once. Ammonia or soap and water are effective antidotes.

Action on the Zinc.—Before considering other types of batteries, a curious phenomenon must be observed in connection with the zinc. If a rod of zinc is used as one element and a rod of carbon or copper as the other, then when both are inserted into a dilute solution of sulphuric acid effervescence immediately begins in the neighborhood of the zinc. The acid attacks the zinc in the following manner:

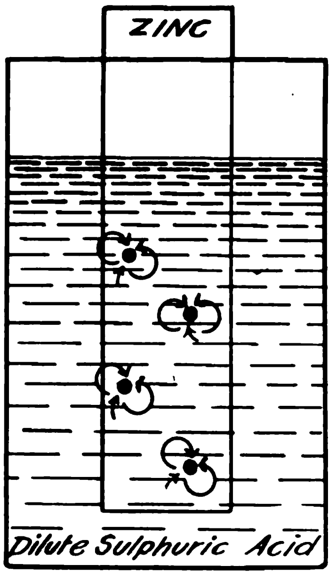
Sulphuric acid + zinc = zinc sulphate + hydrogen

$$H_2 SO_4 + Zn = Zn SO_4 + H_2$$

This simply means that the acid and zinc combine forming zinc sulphate and thus releasing the hydrogen of the acid, which passes over to the negative plate and unless interrupted polarizes the battery.

In an ideal cell, the zinc should not be consumed unless the battery is in use. And it may be furthermore stated that *pure zinc* will not eat away in a dilute sulphuric acid solution. The question then naturally arises, "Why does the zinc eat away at all?" To answer this question correctly, it is necessary to understand this fact: that commercial zinc is impure, and in consequence of this, the impurities with which it is permeated, such as particles of iron and carbon, etc.,

form small voltaic cells with the zinc in which they are embedded. This causes intense chemical action and the zinc



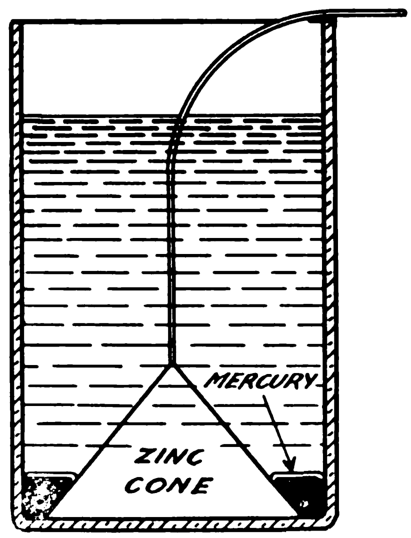
IMPURITIES IN ZINC CAUSING MINUTE CURRENTS TO WASTE IT AWAY.

wastes away, whether the cell is in use or not.

Amalgamating the Zinc.—To remedy this serious and otherwise insurmountable defect, a coating of mercury is applied to the zinc rod. First the zinc is dipped in a solution of dilute sulphuric acid, and then after it is thoroughly clean, the mercury is poured over it, or it is dipped into a dish or bottle containing mercury. If a rag is used the amalgamating process is carried on more successfully.

Principle of Amalgamation.—The action of the mercury is as follows: It dissolves the zinc, leaving the impurities behind, and thereby presents to the action of the acid a coating of pure zinc mixed with mercury. The mercury is perfectly neutral, and in consequence a well amalgamated piece of zinc may be allowed to remain in an acid solution for many days without any waste of the zinc taking place. A bichromate of potash battery supplied with well amalgamated zincs, will use up the zinc only when the battery is in use. If there are impurities in the mercury or acid, a slow action will take place, and the zinc if allowed to remain in the solution will disappear. This difficulty has been met in at least one ininstance by the invention of a means of automatically amalgamating the zinc.

Automatic Amalgamation.—A cell called the Fuller mercury bichromate employs the following method of automatically amalgamating the zinc. Instead of using a zinc rod, a cone of zinc is employed. This rests at the bottom of a porous jar, and into the jar a tablespoonful of mercury is poured. A dilute solution of sulphuric acid is then poured into this jar. An outer glass jar holds a bichromate of potash solution, and in this solution



AUTOMATIC AMALGAMATION.

either one or more carbon rods are suspended.

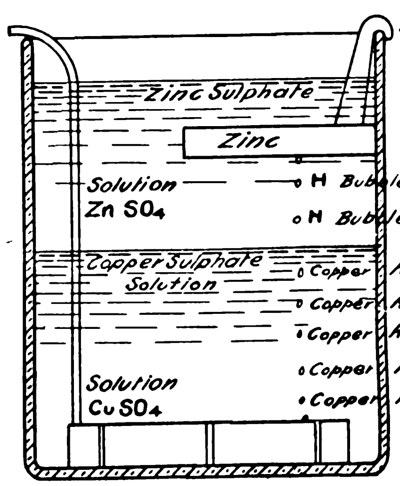
If the acid solution acts upon the zinc, there is always mercury there to heavily reamalgamate it. This is of course an automatic action, the mercury climbing up the cone of zinc, and thereby preserving its integrity until the battery is on closed circuit. The hydrogen which is released passes through the walls of the porous jar, and meets the bichromate solution which combines with it.

A cell of this description may be used for continuous work, and will under these circumstances deliver a strong current. On the other hand, if used only occasionally, it will act as an excellent open circuit battery, because no waste of material can take place when it is not in use. Evaporation will occur, and the acid may lose its strength in the course of time, but cells of this character are good for several years of service on open circuit and are exceptionally reliable for closed circuit work as well.

Recapitulation.—In relation to polarization, two methods have been considered: the mechanical and the chemical. In order to preserve the scientific as well as the practical point of view taken in connection with batteries, it is well to state that the wasting of zinc in a cell when it is not in use, or, in other words, the purpose of amalgamation is to prevent "local action." This is the term employed to describe the injurious effect of the presence of impurities in zinc. It has been attempted by manufacturers to cast the zinc with mercury, and thus offer on the open market a zinc presumably free from local action when in use. The effect was unsuccessful, because the zinc did not retain enough mercury to make such an alloy equivalent to thorough amalgamation, neither has it been found possible, except in rare cases, to substitute any other metal for zinc in a battery. Thomas A. Edison has succeeded to some extent, but the fact remains, that to-day, both dry and wet cells employ as an indispensable element, zinc, and in addition a passive plate of carbon or copper.

Electro-chemical Method of Depolarization.—The third method of reducing or removing the hydrogen from a battery may be found in the first popular type of cell in practical use. This cell, greatly used to-day, and exclusively employed in this country in the past for telegraph lines is called the gravity battery. The name was given to it because the two solutions this battery holds when in normal action are separated from each other solely by gravitation. The two solutions are respectively sulphate of copper, which is in this case the under layer and sulphate of zinc, the layer of solution resting on the first. Their specific gravities prevent them from mixing as long as they remain undisturbed. In this cell a crowfoot of zinc is suspended above in the sulphate of zinc solution. Below is found a cross of copper surrounded by a solution of sulphate of copper, and with copper crystals heaped around it.

The zinc is acted upon by the solution around it and hydrogen gas is produced



HYDROGEN MELTING COPPER SOLUTION AND COPPER CONTINUING IN ITS PLACE.

which seeks to travel downward to reach the copper cross below. Here it enters the sulphate of copper solution at the point where both meet. The sulphate of copper solution seizes hold of the hydrogen gas, but substitutes for it a particle of pure copper.

The pure copper particle continues to travel toward the copper cross the same as if it were the hydrogen bubble. It follows the same route and finally attaches itself to the copper cross. This action, instead of interfering with the output of

electricity from the cell, improves it. When the hydrogen gas meets the sulphate of copper solution the following exchange takes place:

Hydrogen + sulphate of copper = copper + sulphuric acid.

$$H_2 + CuSO_4 = Cu + H_2SO_4.$$

This means that when hydrogen gas and sulphate of copper combine, sulphuric acid is made and pure copper (Cu) is separated. In the electro-chemical method of depolarization the hydrogen gas is held, and the resulting copper sent on in its place over the same path to deposit itself instead of the hydrogen on the copper element. This of course results in an accumulation of pure copper on the copper element, the complete absence of polarization and an absolutely continuous current of electricity of increasing instead of diminishing strength.

This brilliant idea of substituting, through the agency of electricity, a metal in place of the hydrogen gas is originally due to Daniell, the inventor of the famous Daniell cell, at one time accepted as a standard of electric potential, but subsequently converted into the now better known, gravity battery. The Daniell cell, like the gravity battery, makes use of the same elements and naturally operates along the same general lines.

A Novel Compass.

It is reported that satisfactory results have attended the use of the electrical apparatus devised by a French inventor, M. Heit, in connection with the compass for registering automatically, minute by minute, the direction followed by the vessel. The compass card, instead of having at its center an agate resting on a fixed steel point, is fixed on a steel pivot which rests on a fixed agate. The latter is immersed in a small quantity of mercury which serves to conduct the current of electricity that makes possible the registering of the movements of the compass. For this purpose the card has attached to it a small silver index, which is kept in constant electrical communication with the pivot by a fine and flexible wire. In the usual position this index does not touch the fixed basin surrounding the card, but by means of the electrical current the circuit is rapidly closed and opened, with the result that the angle of the boat with the meridian is registered. For this purpose the basin is divided into a certain number of sections, isolated from each other and corresponding in each case to a special circuit, the registration being made on a sheet of paper by means of a spark produced by a small induction coil. Certain sections of the basin also correspond to certain call bells, the commander thus being instantly informed of any abnormal deviation in the direction of the vessel. The apparatus also gives the speed of the boat by registering the revolutions of the screws, a circuit being closed and a signal sent to the receiver at each stroke of the engine. In case of accident, reference to the chart enables any alteration in the position of the vessel, and the time of such alteration, to be detected, so that responsibility can be located.—"Electrical Engineer," London.

IS THE AUTOMATIC TELEPHONE SYSTEM BEST FOR THE TELEPHONE PATRON ?*

BY P. KERR HIGGINS, A.M.I.E.E.

(*Concluded from page 319.*)

SPECIAL EQUIPMENT.

I am satisfied that 95 per cent. of all special equipment now in use in Los Angeles on the manual system, can be duplicated in the automatic, and many forms of equipment not now in use can be furnished by the automatic apparatus.

PRIVATE BRANCH EXCHANGES.

These are now a special feature of the automatic and can be made full automatic, or the present equipment can be made to work in conjunction with the automatic. When full automatic is introduced, and I advocate it as the best for this special service, the telephone company will be obliged to charge a higher rental for the equipment, as it costs about three times as much as the other, but this is more than paid for when we consider the fact that we dispense with the services of an operator at, say, $30 per month, and get superior service, not to say anything of the fact that we get night and day service, whereas now we do not.

I do not believe from my present knowledge and investigation that in small towns the automatic as developed is preferable to the manual, not because it is not as good or even better, but because of the first cost. I have not yet made up my mind at what point the manual leaves off and the automatic takes up, but it is in the neighborhood of 500 lines.

All over the country one of the greatest drawbacks to manual service is the difficulty of obtaining efficient help, and this of itself has almost compelled the operating companies regardless of expense to adopt automatic.

*Paper read before the Engineers and Architects' Association, Los Angeles, Cal.

THE SUBSCRIBER'S TELEPHONE SET.

The telephone set at the subscriber's office or residence, in the case of the manual full central energy, has been developed through a series of revolutions until to-day it is the acme of perfection as regards simplicity. It is almost inconceivable to think of anything more simple, and at first glance it seems like taking a step backward to introduce the very complicated automatic set, but the same might also be said as regards modern machine tools, linotype printing machines, etc., yet no one denies that their introduction is a distinct success.

We have been spoiled by the recent simplicity of the telephone, in which we simply take down the receiver and get central and so take rather unkindly to having to set up our own number, but this, as we become accustomed to the other improved features, will be found only a means to an end, and the fact that we control our own connection throughout is a very great source of satisfaction. I believe that the automatic telephone of the future will be one in which the subscriber sets up his number, the same appearing before him visually, so that he can see whether or not he has made any mistake, and the number will be turned into central by the act of taking the receiver down off the hook. There is at present one drawback in the automatic set which will be overcome at an early date—it cannot intelligently be operated by a blind person, an illiterate man or in the dark. The first and last will be overcome very shortly by the introduction of a lamp which can be lit by pressing a button. A man who does not know figures can never work the automatic and will have to depend on others even as he does now in other things. The day of the illiterate man is rapidly passing away and it is only a question of a short time until education will be an absolute necessity to existence among modern methods and apparatus. The size of the automatic machine, especially the desk style, is also against it, but this will be materially cut down as its introduction is hastened. Batteries are now necessary at the sub-station but will be dispensed with in the near future.

THE LINE CONNECTING CENTRAL AND SUB-STATIONS.

The lines necessary to connect an automatic station to central is the same as in the manual except that an additional wire connected to a water pipe or other good conductor to ground has to be provided for signaling purposes; this also is addi-

tional expense to the operating company but does not affect the subscribers.

PROTECTION FROM DANGEROUS SOURCES.

The protection necessary and provided for in the automatic is the same as in the manual, there being more necessity for high insulation in lines and cables in the automatic than in the manual, because of the increase of voltage necessary in the former for signaling purposes, and as this is at all times on the line while not in any sense dangerous will show up low insulation on the line or in the apparatus much more quickly than in the manual; hence the operating companies are compelled to maintain their plant to a higher standard of efficiency in automatic than in manual practice.

FACILITIES FOR BALANCING OPERATORS' WORK.

In manual practice it is customary to provide an intermediate cross-connecting rack for the special purpose of balancing up the work of the operators; this is entirely dispensed with in the automatic and removes a number of contacts from the circuit, eliminates a certain proportion of trouble and represents a saving to the operating company; this also permits a subscriber's line to be changed without changing his number, which can also be done in the automatic.

SIGNALING APPARATUS SUBSCRIBER TO OPERATOR.

In manual practice it is necessary to provide a signal which may be either a target, annunciator or miniature lamp operated by a relay to advise the operator that a call has been turned in. This is dispensed with in the automatic and is replaced by the automatic operator, which receives the signals from the subscriber and performs the functions of the manual operator; beneath the lamp is a jack or line opening into which the operator on receiving the signal inserts a plug which connects her telephone set with the line calling, and enables her to answer the call; having received the number wanted she takes up the other plug of the connecting pair (all cords being in pairs and known as the answering and calling cord); the plug attached to this cord is then inserted in the jack of the called number, the controlling key pulled into the ringing position, which automatically rings the subscriber called and the key automatically returns to normal, leaving the parties connected, one miniature lamp is attached to each cord and automatically indicates to the operator the movements taking place at the subscriber's end. These are called the supervisory lights or lamps and indicate to the operator whether parties have answered the call, are still talking, or are finished, and she acts according to these signals. If they fail to work then party is cut off in the middle of his conversation, or if the cords are defective or become defective during the conversation the same takes place and necessitates making up the connection anew. All this is entirely eliminated in the automatic, no cords of any kind being used.

TESTING CALLED LINE FOR BUSY TEST.

In manual practice all subscribers' lines are duplicated in front of every section of the switchboard, consisting of three operators each; this enables each and every operator to connect with every line on the system if not in use. It therefore becomes necessary to provide a means of notifying operators when a line is busy and is done as follows: The operator wanting a number will take up the calling plug which is in three sections—tip, ring and sleeve—and touch the sleeve or body contact of the number wanted with the tip of the calling plug; if line is clear no sound is heard in operator's receiver; if, however, line is busy she gets a distinct click in her receiver and she immediately advises the party that the line wanted is busy. In the case of the automatic a similar arrangement is provided, the subscriber receiving the signal of a busy line instead of the operator. This saves time and possible mistakes.

MEANS FOR CONNECTING TWO LINES TOGETHER.

This has been explained already. Each operator's position is provided with 15 pairs of cords, lamps and 15 keys. These keys have three distinct movements or positions—(1) ringing, (2) listening, (3) connected. In position 1 the called party is rung, in 2 the operator is taking the call, in 3 the operator is cut out and the two parties are connected together.

With these 15 pairs the business of from 100 to 140 lines is taken care of. Under ordinary conditions this is found amply sufficient. In the automatic a larger percentage of connections is possible and this apparatus is dispensed with. The pair of cords simply represent a conductor connecting the calling line with the called line and attached to that conductor mechanical means for manipulation of same and for supervision and for signaling the called subscriber.

MEANS FOR SIGNALING OPERATOR DURING A CONVERSATION.

It is possible in manual practice for a subscriber during a conversation to call the operator, if for any reason said conversation is unsatisfactory, or if he desires another connection. The act of moving his receiver hook up and down makes and breaks the battery current and flashes the supervisory lamps. When following instructions the operator is supposed to put the key in the listening position and inquire what is wanted. This is not necessary in the automatic, as the subscriber can remake his own connection or get a new connection by hanging up his receiver, which grounds both sides of the line and restores all conditions to normal at once.

MEANS FOR DISCONNECTION ON SIGNAL.

The manual operator on both supervisory lamps lighting is supposed to take out both plugs and restore the lines to normal; if, however, she is busy or careless this is not done at once and some delay ensues, and to the busy man it is very annoying. In the automatic this is entirely in his own hands and he can ring up as many calls as he wants, one after another in as rapid succession as he may wish, and never once get the operator tired or out of patience. This is very satisfactory and of itself when fully appreciated will materially help to win the subscriber over to the automatic.

OPERATORS.

It is very nice to go to the telephone and talk with an operator when she is pleasant, but it is also one of the most aggravating things in the world to have at the other end of your line an operator who is unpleasant. Their moods are very variable and cannot for any length of time be depended upon, and if they talk to you they will talk to others and consequently the work is neglected. No one will question the statement when I say that it is simply impossible te get the uniform, quick, clean service out of a human being that you can get out of mechanism; again, good operators, like musicians, are not made, they are born; not one in fifty are in my opinion born operators and so it is hard to get them, and I am sorry to say harder to keep them. A good operator makes a good wife or sweetheart, and as a result we lose our good operators much more quickly than our bad ones; others find out and the first thing we know they are engaged and a short time afterwards they are gone, married, and so it is on down the line. One of the hardest things an operating company has to contend with is the operating help, and it is not only here but all over the world. The automatic comes to our relief, the subscriber has no one to blame but himself for his mistakes and the operator never gets saucy or impertinent.

A METHOD OF MEASURING MAGNETOMOTIVE FORCES.*

BY RUDOLF GOLDSCHMIDT.

Modern electrical machines are, as a rule, highly saturated in the iron of the magnets as well as in the teeth of the armature. The higher this saturation, the more the ampere turns of the fields are dependent upon the magnetic properties of the iron and on accidental faults in the magnets, such as blow-holes in the cast steel or bad joints. In any case it is very important, from the designing and manufacturing point of view, to find out from the actual machine how many ampere-turns are required for driving the flux through the magnet yokes and poles, the air-gap and the teeth of the armature.

The method of measuring the "magnetic potential drop" was the outcome of special tests, which it was found necessary to make on actual steel field magnets which were suspected of being faulty in quality and casting, and the results proved that it was extremely suitable for the purpose, being easy to manipulate in the shop and requiring a minimum of special apparatus or fine adjustment,

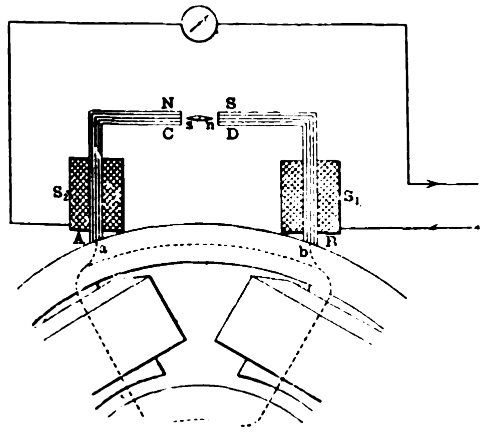


FIG. 1.

which would obviously lead to complications. To measure the "magnetic potential drop" between the points a and b in the yoke of a continuous current machine, two laminated iron cores, AC and BD, as shown in Fig. 1, are placed on a and b respectively in the manner shown, the gap CD being from $\frac{3}{4}$ inch to $\frac{7}{8}$ inch. By this arrangement we have formed a small "magnetic shunt" or "by-pass" to the yoke. This shunt will take up a small amount of the magnetic flux. Point C, for instance, will show north polarity, point D south polarity, and a small compass needle placed between C and D will assume the position indicated in Fig. 2, pointing with its south poles to C. The limbs AC and BD carry two coils, S_1 and S_2, which we excite with a current so that they counteract the magnetic potential between a and b. If we increase the ampere-turns of S_1 and S_2 sufficiently to overpower the magnetic force of a-b, then the flux in the "magnetic shunt" would reverse, the polarity of C would become north and the polarity of D south,

FIG. 2.

FIG. 3.

and our compass needle would point as shown in Fig. 3. If we adjust the current in S_1 and S_2 so that the compass just begins to move from one position to the other the magnetomotive force of the coil is equal to the P.D. between a and b, and thus represents directly without any further calculation the amount of ampere-turns required to drive the flux through the yoke of the machine. From the foregoing it will readily be seen that it is not necessary to have a very good fitting joint between the field magnet and the test cores, this being a zero method.

The method, as here applied to the yoke of a continuous current machine, can, naturally, be used in any case where magnetomotive forces are to be measured. As to the exactness of the method, I may say that this was tested by measuring known values of known magnetomotive forces, and by summing up the different potential drops in simple as well as in more complicated magnetic circuits, it was found that the measurements agreed sufficiently well for all practical purposes. For instance, the measurement of a known value of ampere-turns was carried out with satisfactory results on a choking coil in which the drop of magnetic potential in the iron was insignificant, and practically the full amount of the ampere-turns in the choking coil could be measured by the apparatus.

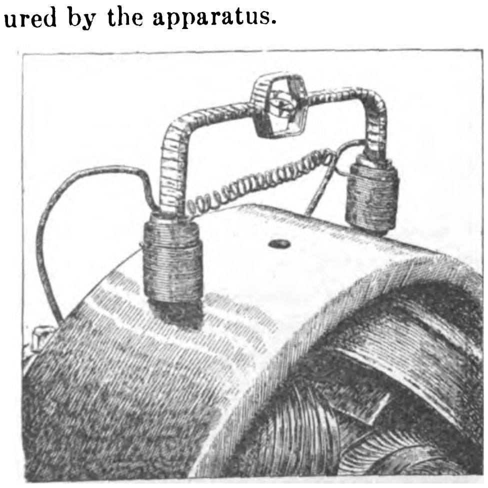


FIG. 4.

Among other measurements the most interesting, perhaps, is that of the magnetic potential drop in the different parts of the magnetic circuit of a continuous current machine. Fig. 4, drawn from a photograph, shows the apparatus applied to a continuous current machine by Messrs. Crompton & Co. An actual measurement showed that the drop in the yoke was 300 ampere-turns; over the air-gap and teeth, 6,400 ampere-turns; over the teeth alone, 600 ampere-turns. The actual ampere-turns on the field of the machine were 7,300. The difference be-

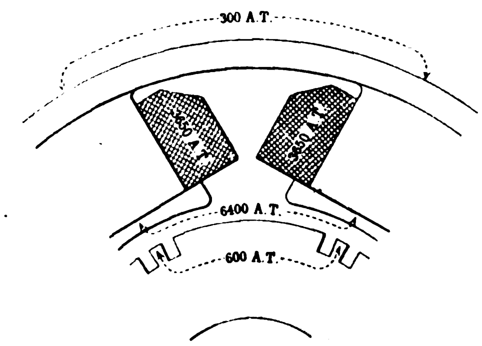


FIG. 5.

tween this amount and the sum of the single measurements—that is, 7,300 − (6,400 + 300) = 600—represents the drop in the two poles, or 300 ampere-turns for each pole. Fig. 5 shows a diagrammatic

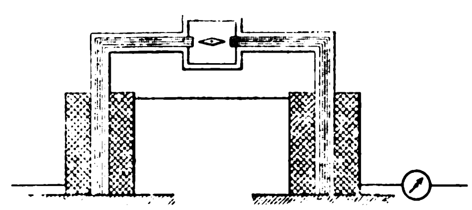


FIG. 6.

sketch of the magnetic circuit with the figures inserted as they were actually determined by the apparatus. To shield

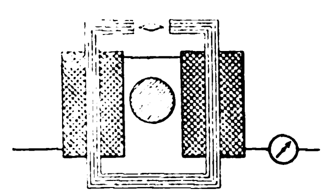


FIG. 7.

the compass needle from the influence of undesirable stray lines, the compass can be surrounded by a small iron box, as shown in Figs. 4 and 6.

From a great number of applications where this apparatus may be used, we may mention the following:

1. Measuring the "drop" for the different yokes and parts of a continuous current machine so as to detect irregularities and blow-holes in the iron. By special arrangements this can also be applied to the poles.

2. The apparatus can be used to obtain the full magnetizing curves of the armature teeth of electrical machinery, which otherwise would be available only by calculation. With this test the flux can be determined in the ordinary way by run-

*From the "Electrician," London.

ning the machine and measuring the voltage on the armature.

3. It can be applied for detecting bad joints in any part of the yoke of continuous current machines, which sometimes give rise to "out-of-balance" occurrences in machines with parallel coupled armatures.

Fig. 7 shows a peculiar application of the method for measuring the continuous current in a conductor—say a feeder cable—without inserting an amperemeter or cutting the cable in any way. An iron yoke carrying the magnetizing coils on its limbs is put over the conductor, and the coils of the yoke excited so that the flux in the magnetic yoke is zero, which can be ascertained by means of the compass needle in the way described. Tests carried out show that an accuracy of within 1 or 2 per cent. can be obtained.

With regard to the sensitiveness of the method, I may say that with a good compass needle a discrepancy of 1 or 2 per cent. from the balancing amount would indicate itself by making the needle move to one or other position.

To ascertain balance, other ways have been tried besides the compass-needle method, but the latter has been found to be the best. I may mention one. Besides the exciting coils, S_1 and S_2, an exploring coil was placed on the magnetic shunt circuit and connected to a milli-voltmeter. To ascertain if the balance was obtained—i.e., if the shunt circuit did not carry any flux—the magnetic resistance of the shunt was altered by inserting an air-gap. The excitation in S_1 and S_2 was then adjusted until no deflection was indicated on the milli-voltmeter, when the magnetic resistance was thus varied, showing that balance had been obtained.

THE COMING OF THE GAS TURBINE.*

BY E. KILBURN SCOTT, A.M.I.C.E., M.I.E.E.

It is not generally known that, some five or six years ago, experiments were being made in Leeds with a gas turbine. The machine was modified from a De Laval, and was actually made to run. Certainly, it did not run very long, and nothing much has been heard of it, but this is partly attributable to the limited resources of those engaged in the work.

Since then, the rapid development of steam turbines and large gas engines has shown that the days of the reciprocating steam engine are numbered, and this is, naturally, having the effect of causing steam engineers to look around for a new prime mover, and some in this country are already at work on the gas turbine.

One of the more significant facts which came to the writer's knowledge during a recent visit to the United States, was that both the large electrical concerns (at Schenectady and Pittsburg) were experimenting with gas turbines. It is only within recent years that either of these firms, or, indeed, any one in America, has seriously considered turbines, but when they took hold of the steam engine, they lost no time in developing it, with the result that one has now to go there to see the latest and largest practice. It is all the more interesting, therefore, to find them at work on the gas turbine problem.

The paper read recently before the Institution of Mechanical Engineers by Mr. R. M. Neilson, on the possibilities of gas turbines, comes at a very opportune time, and it is an especially valuable contribution, because the author carefully points out the theoretical principles which investigators must bear in mind. He shows that when working on Carnot's cycle, between 1,600 degs. and 17 degs. C., the greatest possible efficiency is:

$$\frac{T_1 - T}{T_1} = \frac{(1{,}600 + 273) - (17 + 273)}{1{,}600 + 273}$$

= 85 per cent.

While a reciprocating gas engine working on the Otto cycle with compression to 60 lbs. per square inch, combustion at constant volume, and expansion to atmospheric pressure, gives at most only 37 per cent. An important point to note is that it is relatively more important to have the lower temperature *low* than to have the higher temperature *high*. Thus an ideal gas engine working on Carnot's cycle between the limits of temperature 2,000 degs. C. and 300 deg. C. absolute, will lose as much by an increase of 100 degs. C. on the lower temperature as it will by a decrease of 500 degs. C. from the higher temperature. This is good, because it is clearly much easier to build a turbine for a low temperature than for a high one, indeed, it is doubtful whether turbines can be water-jacketed effectively to withstand an initial temperature of 2,000 degs. C.

Of course, in any form of motor-using gas, a large amount of heat must necessarily be lost in the water, and the higher the initial temperature the greater will this amount be. It has been suggested to utilize this heat by raising the water to boiling point and then passing the steam along with the gas through the turbine, but clearly a better way would be to utilize the steam in the gas producer, and thus dispense with separate boilers.

One of the principal difficulties which has to be met in turbine design is to fully utilize the full velocity of the steam or gas. Thus saturated steam at 300 lbs. absolute, expanded adiabatically from a De Laval nozzle, has a velocity of over 4,000 feet per second, and with gas the velocities which will have to be dealt with, are likely to be still higher. Now, such velocities as these are far greater than the peripheral speed at which metallic bodies can be run.

The difficulty has been very fairly met in the Curtis, and to some extent in the Westinghouse steam turbines for Chelsea, by arranging the expansion in stages and combining the De Laval nozzles with Parsons' vanes. It is probable a construction such as this will meet the conditions of the gas turbine.

One advantage which gas has over steam in a turbine, is that there cannot be any water present with the former, and therefore liability to cut the blades as well as friction in the nozzles, etc., is reduced.

It is, however, not so much the steam turbine as the gas engine, that the gas turbine will eventually have to reckon with. The usefulness of steam machinery is limited by the wasteful method of burning coal on a fire grate, and also because steam boiler units cannot be built much larger than 1,000 hp. Therefore, however much the steam turbine itself may be perfected, it will always be handicapped by the boiler side of the proposition.

In order to more fully understand the chances of the gas turbine as the coming prime mover, it may be interesting for a moment to draw some comparisons between the gas engine and the gas turbine:

(a) It is clear that one great advantage of working with gas, is that in a turbine it can have practically a continuous flow, whereas in the engine it must be cut off at every working stroke—usually one in four—with a liability to back firing, which is absent in the turbine.

(b) The turbine is able to do its own scavenging automatically, by the mere fact of the gas entering at one end, and the products of combustion leaving at the other. With an engine the charge may be, and generally is, compressed in the cylinder, but in a turbine it must be compressed separately. This can be affected in a simple manner by the turbine rotary pump, which has been developed with such success in connection with colliery ventilation, etc.

(c) Perhaps the greatest difference be-

*From the "Electrical Review," London.

tween the gas engine and turbine, is that in the engine the metal surface with which the gas comes into contact, is small compared with a gas turbine, especially if multiple expansion is attempted, because almost every particle of gas must necessarily slide along a metal surface as it passes through the vanes. Fortunately, however, the rotating and fixed portions do not come into intimate contact as is the case with the piston and cylinder of an engine, and, therefore, the metal surfaces may be worked at much higher temperatures.

(d) As with engines, so gas turbines will require to be water-jacketed, the extent of such jacketing depending on the method of working. For example, if the temperature is below 1,000 degs. C., it is probable that jacketing the outer casing may meet the requirements. For 2,000 degs. C., however, it will be necessary to have water circulating through the spindle, and the rotating rings and blades. At first sight this may be thought somewhat difficult, but after all it is much less of a mechanical problem than providing a water supply in the piston of a large gas engine, which latter is necessary to prevent back-firing.

(e) Regarding the governing, there is on the face of it a distinct advantage in favor of the turbine, because of its not having any dead center, and the regulation can be so simply affected by shutting off more or less nozzles as in the Curtis steam turbines. The gas engine, on the other hand, requires a heavy flywheel, and if economy of gas is aimed at by using the hit-and-miss form of governor, then the flywheel becomes exceedingly heavy.

So far as actual construction is concerned, the principal difficulties experienced up to now, have been the sooting up of the nozzles and other working parts, and the shrieking noise, the latter being perhaps the more formidable of the two. The Hon. C. A. Parsons, C.B., had a much tougher job before him when he developed the original steam turbine, for the modern investigator has a mass of facts to work from, and he is also at an advantage in having better and stronger materials, and much more accurate machine tools at hand. A large number of the details must be the same as for a steam turbine, and the elaborate gas engine trials of recent years are available for the investigator.

Water wheels are fairly common in China, but windmills are practically unknown, though China is by no means a windless country. Simple wind motors, costing little and easy to erect, could well be used for many purposes where cheap power is required, especially for pumping and general irrigation work, and once introduced their simplicity and comparative cheapness would appeal to the native mind.

SOME DIFFICULTIES IN GETTING ON.*

BY J. SWINBURNE.

(*Concluded from page 317.*)

A man's value to the world at large may generally be roughly estimated by the income he earns. Where position is earned at the same time, the money income is in proportion less for a given usefulness; but taking such disturbing elements into account, the rule is broadly true. The business man comes out far away above the engineer. He employs the engineer; the scientific man is his servant. Just as the raw scientist looks down on the engineer, and the engineer looks down on the business man, so the business man has a contempt for the engineer; and the engineer in his turn looks on the raw scientist as an unpractical crank. So much is this the case that the business man will not trust the engineer more than he can help. He assumes that if you know anything about anything you cannot possibly be a business man. I remember a board of directors finding fault with a report of mine because I said that making a certain article would pay. They said that such a statement was outside of my province altogther, as I was a scientific man, and therefore could not possibly know whether a manufacture would pay, as that is a business question. As a matter of fact, I had at one time charge of a factory for making the article in question, but that did not matter; I was scientific, therefore it was not possible I could have any commercial sense. Now, how has such an idea come about? Is it not because scientific people profess such a contempt for business that they do not trouble about it, and thus remain so useless that such ideas as those of my board are based on a foundation of truth.

If you examine the large industries you will, as I say, find the commercial or business man with little or no technical knowedge at the top of the tree. If you confine your attention to engineers, you find the engineers who make the biggest incomes and who occupy the most important and responsible positions are those who have most business or practical knowledge. Our leading consulting engineers do not spend a large portion of their lives plotting curves, counting electrons or even making anything more than arithmetical calculations. They spend their time dealing with large questions on purely commercial lines; and as a rule the bigger the engineer the more he knows about practice and business and the less he knows about text book science. I do not for a moment mean to say that text book science is not of priceless value; of course it is; and the more scientific knowledge you or I, or still more, the leading engineers have, the better; but most of us suffer from too little common-sense in proportion to our scientific knowledge.

The engineers occupying smaller positions, assuming the same age in both cases, are not necessarily deficient in technical knowledge; but they are generally wanting in business attainment and less able to take responsible positions. It is often said to be a good master you must have been a good servant; but a good servant does not necessarily make a good master, generally the reverse. There is a wide distinction between the man who can earn a few hundreds a year and the man who earns as many thousands. It is a very curious thing that there is hardly anything between. One type of man will either earn his few hundreds a year all his life, remaining permanently an assistant, or he will undertake responsible work and get into fair figures. The engineer who is worth £750 a year seems hardly to exist, except for a short time on his way from one class to another. This is what is meant by the saying that there is plenty of room at the top of the ladder. It is not that men who remain as assistants permanently are ignorant of science—quite the reverse. The business man may rent a profound mathematician for a very few pounds a week if he wants him; but he probably does not. The real point is that the assistant is wanting in business knowledge or push. If he is wanting in ambition, or lazy, nothing I can say is to the point; but he may be suffering from a false notion of the relative values of raw science, technology and business knowledge.

If you come down to the raw scientist you find that the industrial world has no use for him at all, and will not pay him anything and will not employ him. The only opening he has is in teaching; and if he is not very unpractical there are a few Government appointments for him. You will find practically all our teachers in raw science are science teachers. It may be said that this shows they are useful. It does not. If young men's education con-

*Address delivered to the Students of the British Institution of Electrical Engineers, November 16, 1904.

sisted entirely of the stndy of Aztec Metempiries, some of the men that did best in Aztec Metempiries might get on in the world, and the brains that made them do well at school, would make them do well in real work. But there would be a certain proportion of men who did well in their studies, but were of an unpractical turn of mind. They would become the teachers of the next generation, and they would teach Aztec Metempiries in a still more unpractical form, till the subject would eventually become as completely absurd as the present public school education. But the fact that teachers of Aztec Metempiries made a living in that way would not prove that they were really of use to the community.

When I say that a man's earnings is a rough test of his value to the world, a great exception must be made in the case of genius. A genius does not work for a given employer; he works for the world at large, and the world at large does not pay him. It would be ludicrous nonsense to say that the value of Newton or Faraday could be reckoned in terms of their pecuniary earnings. They did grand work apparently because they were impelled to do it without any selfish motive. This is true of the great scientific men of to-day. We think now that we have no Newtons among us; the next generation will look back with envy to the present time as the day of great scientific men. The broad rule about measuring a man by his earnings breaks down, not only in the case of great geniuses, but to a proportionate extent in the case of many original workers in unapplied science. As soon as the research becomes a means of advancing the individual by getting him better appointments as a teacher, or getting him kudos—taking genuine kudos as part of the earning, the rule holds good.

In the Charter of the Institution of Civil Engineers the engineer is defined as "Directing the Great Sources of Power in Nature for the Use and Convenience of Man." With all respect to this august body, and their often quoted definition, I would humbly suggest that it is bad. It is really the definition of a scientific man. It is incomplete as applied to an engineer, because it does not take into account the sordid element of price. An American definition is much better: "An engineer is a man who can do for one dollar what any fool can do for two." This is not poetical, and is useless for oratorical purposes; but it is right. It is no use being able to design most complicated alternating-current machinery, or being able to explain it with the help of a wilderness of clock faces and several issues of the technical journals, unless the machine, when made, is cheaper than its rivals. Every design, every engineering manufacture, and every piece of engineering is only a question of price.

It is cant to profess contempt for money. The poet professes to work for fame, and so do the musician, the artist, the philosopher, the scholar or the man of letters. They generally like money; but apart from that they are merely satisfying their proper vanity, or love of approbation, by getting ahead of their fellows. But that is all you want to get on for. Money is nothing in itself, it is only a means, and making it is merely a way of going ahead of your fellows. People who cannot make money do not like it being used as a criterion, so they run it down. Everyone thinks the world ought to be judged by what he can do best himself. If you want to be poets you have my sympathy, but I cannot deal with you in this address. I can only ask you to eschew cant.

I cannot tell you how to be engineers, because I do not know. All I can do is to make you realize some of your wants; and if you know what you want, you are more likely to get it. One of the greatest diffiulties in getting on is to find a good opening. At present, especially, times are very bad, and many big incomes have fallen to negligible quantities. The profession, or business or trade seems to me to be overstocked; but everybody is apt to think his own business overrun. Most of you have probably had, or are having, very thorough college trainings. Unfortunately, you will find that even good college educations are not of high market value. That is largely because technical colleges are subsidized, so that education costs the student little money. This tends to reduce its market value, however good it is in itself. You will find all about this in books on political economy. Mill deals with it I am sure.

Then as to the different branches of the business—business is really a higher title than profession—in which are you to find openings? From the number of applications I receive from young fellows, it seems to be a common idea that consulting engineering is a good thing to begin upon. It is a curious notion. A consulting engineer is supposed to be a skilled engineer, with so much experience that he is an authority. I should have thought at least 20 or 30 years' experience, apart from school and college training, was necessary for a consulting engineer to be worth his salt. But there are various grades of consulting engineer; and I am entirely at a loss to know what the qualifications of the consulting electrical engineer really are. Then still less do I know what the consulting electrical engineer will be by the time you have had 20 or 30 years' experience. At present most of the large towns are electrically lighted and have their tramways; railways will be electrified by that time, and it is probable the work will be done by their own men. Supervising contractors who are doing wiring, will not be much of a profession in 20 years; and if that is consulting engineering, I do not think so much as 20 years' training is necessary.

In manufacturing work there is the designing of dynamos, motors, transformers, and so on. This was considered high grade work when I was a young man; and even very able men built some very queer machines in those days; and we were all pretty ignorant. But the works were smaller then, and the salaries for dynamo designing were not princely. But now there is not much opening in electrical machine designing. There is some, of course, but it is not as it used to be. There are many openings to be had in central station work; and stations are growing bigger and more important every day. At present there are also many applicants for every opening. Central station work in a position of responsibility is very anxious. I do not think that it is very well paid either. You will find exceedingly able engineers in most of the large town stations; and I am sorry to say their incomes are often very small for men of their technical and commercial ability. The assistants are often poorly paid, especially I think in municipal stations; although I do not know why this should be.

A large number of young men go in for installation work—which sounds as if they started bishops on their episcopal careers—but really means that they do what is in fact electrical plumbing, under an unnecessarily imposing name. There are a great many of them, and they seem to spend most of their time going into and out of partnership with one another, like ions, and sending notices round to that effect. At other times they go bankrupt and send no notices. The upper grades in teaching science are well paid, more especially as a position goes with an appointment, and there is time and facility for original research, which is a luxury and brings reputation. Moreover, a steady income with no expenses is a very blessed thing. But the lower grades are very poorly paid in proportion to their ability.

All this may sound rather discouraging, but I am dealing with the difficulties of

getting on, and I am sure it will not discourage anyone who is worth his salt. At first it is very discouraging to make very little, and the good man has little chance of showing his superiority to the common run. But he should always remember that income as a young man is very little criterion of real value.

I have only mentioned a few of the difficulties in getting on. I am sorry to say there are many more, which you will find out in good time.

New York Edison Company's Banquet.

The New York Edison Company tendered a banquet to its agents and inspectors, at the Hotel St. Denis, on Tuesday evening, November 29. Besides the officers of the company, more than 80 members of the contract and inspection department were present. The affair was a decided success in every way.

At the speakers' table sat Nicholas F. Brady, Thomas E. Murray, J. W. Lieb, Jr., A. A. Pope, C. A. Littlefield, R. U. Conger, of the Sheldon School of Scientific Salesmanship, and Arthur Williams, who presided.

Mr. Lieb was introduced as the first speaker of the evening. In making the introduction, Mr. Williams rehearsed the development of the company from the time when the entire territory supplied covered less than 1 square mile, when there were less than 300 customers, and when there were no arc lamps. To-day the territory exceeded 17 square miles and there were 34,000 customers and about 23,000 arc lamps. At the present time there was 90.000 hp. in motors engaged in every industry in New York city in which mechanical power is used. The customers of the company during the last five years have increased from 16,000 to the present number. The number of incandescent lamps installed has increased from 750,000 to 1,600,000, and the arc lamps from 10,000 to the present number.

In his remarks Mr. Lieb referred to the early history of the lighting industry of New York city, and sketched the change in policy of electric light companies and gas companies, and the vigorous methods pursued for the securing of new business. He recognized the necessity of the various departments of the company meeting from time to time in order to discuss and compare notes. He mentioned the very successful work performed by the Bulletin issued by the advertising department of the company.

Mr. Conger was the next speaker, and he dwelt upon the educational effort that the correspondence schools of the country were making and the part they were playing in the development of salesmen of a high order of ability.

Meeting of the American Association for the Advancement of Science.

The 54th annual meeting of the American Association for the Advancement of Science will be held in Philadelphia, Pa., December 27–31, 1904. There will also be meetings of several affiliated societies during the same period.

The meetings will be held in the buildings of the University of Pennsylvania.

Society of Chemical Industry.

The next meeting of the New York Section will be held at the Chemists' Club, 108 West 55th street, on Friday evening, December 16, at 8:15 o'clock. The following papers will be read: "The Improved Method of Applying Radium," by H. Lieber; "The Chemical Combination of Knall Gas Under the Action of Radium Radiations," by B. Davis and C. W. Edwards; "Commercial Fusel Oil," by Samuel F. Ball, and "The Use of Crude Oil for Roadmaking and Method for Determining the Amount of Asphalt in it," by D. Basil W. Alexander

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DEC. 6, 1904.

Electric Railways and Appliances.

776,534. Means for Automatically Stopping Electric Railway Cars or Trains. William O. Mundy, Louisville, Ky., assignor to the General Electric Company. Filed Sept. 30, 1902.

776,535. Trolley-Hanger. Robert W. McIlvaine, Hamilton, Canada. Filed March 5, 1904.

776,681. Electric Railway. Richard C. Parsons, Reginald Belfield and William Chapman, London, Eng., assignors to the Westinghouse Electric & Manufacturing Company. Filed Nov. 16, 1900.

776,735. Trolley-Wire Clamp and Feed-Wire Support. Thomas A. Furniss, Canonsburg, Pa. Filed Sept. 7, 1904.

776,803. Trolley-Operated Electric Switch. John J. Ruddick, Newton, Mass., assignor to the United States Electric Signal Company. Filed March 28, 1904.

776,826. Electric Propulsion of Cars or the Like. Orestez H. Caldwell, Indianapolis, Ind. Filed Feb. 15, 1904.

776,836. Trolley-Track. Charles A. Gower. Lansing, Mich. Filed July 20, 1903.

776,869. Car-Fender. William H. Sievers, Galena, Ill. Filed Aug. 5, 1904.

776,871. Trolley-Wheel Oiler. William J. Sloan and John E. Robinson, Cleveland, O. Filed April 30, 1904.

776,954. Trolley-Pole. Charles H. Spangler, Atlanta, Ga. Filed Feb. 14, 1903.

777,049. Trolley-Wheel Guard for Electric Wires. John L. Sullivan, Warren, R. I., assignor of one-half to Joseph Harris, same place. Filed April 19, 1904.

777,052. Trolley-Guard. George W. Watson, Kearney N. J. Filed Feb. 26, 1904.

Electric Lights and Appliances.

776,709. Searchlight System. William O. Webber, Boston, Mass. Filed Jan. 6, 1904.

Electrical Machinery and Apprataus.

776,491. Temperature-Compensating Device for Electrical Measuring Instruments. William H. Bristol, Hoboken, N. J. Filed Feb. 23, 1904.

776,521. Electric Switch. Walter S. Levin, New York City. Filed March 28, 1904.

776,522. Electric Switch. George B. Low, Newton Center, Mass. Filed May 23, 1904.

776,526. Electric Brake for Vehicles. Joseph N. Mahoney, Brooklyn, N.Y., assignor to the American Electric Brake Company, New York City. Filed Jan. 21, 1904.

776,546. Brush-Holder. Edward D. Priest, Schenectady, N.Y., assignor to the General Electric Company. Filed April 19, 1902.

776,557. Electric Transmission Mechanism. Charles G. Simonds, Schenectady, N. Y., assignor to the General Electric Company. Filed May 5, 1904.

776,563-4-5. Current-Rectifier. Percy H. Thomas, Pittsburg, Pa., assignor to the Cooper Hewitt Electric Company. Original application filed Feb. 4, 1903. Divided and last application filed Aug. 23, 1904.

776,660. Electric Fuse and Cut-Out. Benjamin H. Glover, Buffalo, N. Y., assignor to the Chicago Fuse Wire & Manufacturing Company. Filed Aug. 13, 1903.

776,682. Plow for Electrically-Propelled Vehicles, Richard C. Parsons, Reginald Belfield and William Chapman, London, Eng., assignors to the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Original application filed Nov. 16, 1900. Divided and this application filed Feb. 20, 1902.

776,752. Power-Transmitting Mechanism. William McHaffie, Tenafly, and George D. Beinert, Jersey City, N. J. Filed Sept. 29, 1903.

776,849. Electric Switch. William Kingsland, London, Eng. Filed March 7, 1904.

776,855. Electric Switch. Ellsworth A. La Har, New Britain, Conn., assignor to the Hart Manufacturing Company, Hartford, Conn. Filed July 30, 1904.

776,866. Electrical Measuring Instrument. Frank W. Roller, Plainfield, N. J. Filed May 15, 1902.

Telephones and Telephone Apparatus.

776,524. Automatic Telephone-Exchange. Frank A. Lundquist, Chicago, Ill., assignor to M. E. Richardson, trustee, Sterling, Kan. Filed April 30, 1900.

776,728. Attachment for Transmitters. William W. Dean, Elyria, O., assignor to the Kellogg Switchboard & Supply Company. Filed Feb. 6, 1904.

776,960. Telephone-Transmitter. George W. Talley, Atlanta, Ill., assignor of one half to Robert D. McKown, Atlanta, Ill. Filed May 19, 1903.

Miscellaneous.

776,490. Electrode. Frank J. Briggs, Everett, Mass. Filed Sept. 19, 1903.

776,536. Self-Closing Telegraph-Key. Noble S. McKinsey and Anton R. Nelson, Susanville, Cal. Filed Dec. 26, 1903.

776,556. Conduit for Electric Wires. Clarence C. Sibley Perth Amboy, N. J., and George A. Lutz, New York City. Filed Dec. 19, 1902.

776,638. Portable Electric Device. Charles E. Avery, Jersey City, N. J., assignor to the Manhattan Electrical Supply Company. Filed April 18, 1904.

776,653-654. Winding and Coil for Electrical Apparatus. Joseph W. Farley, East Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed March 16, 1904.

776,705. Induction-Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed Dec. 30, 1903.

776,789. Insulator. Fred M. Locke, Victor, N. Y. Filed Nov. 16, 1903.

776,876. Apparatus for Wirelessly Transmitting Electrical Energy. Daniel W. Troy, Montgomery, Ala. Filed March 19, 1903. Renewed Oct. 26, 1904.

776,878. Current-Controlling System. William R. Whitehorne Bethlehem, Pa. Filed Sept. 22, 1904.

776,985. Combinational Telegraph Instrument. Francisco G. Barbosa, Limon, Costa Rica. Filed Dec. 18, 1903.

777,014. Apparatus for Transmitting and Receiving Signals. Reginald A. Fessenden, Allegheny, Pa., assignor to the National Electric Signaling Company, Pittsburg, Pa. Original application filed June 2, 1900. Divided and this application filed March 29, 1901.

777,039. Electromagnetic Apparatus. Joseph N. Mahoney, Brooklyn, N. Y. Original application filed Jan. 21, 1904. Divided and this application filed March 19, 1904.

777,046. Thermostat for Electric Circuits. James P. Robertson, North Sydney, near Sydney, New South Wales, Australia. Original application filed Aug. 13, 1902. Divided and this application filed Oct. 7, 1903.

THE TELEPHONE WORLD.

Wisconsin Independent Telephone Association.

On January 25 and 26, the annual convention of the Independent Telephone Association of Wisconsin will be held in Milwaukee. The headquarters will be at the Pfister Hotel, where the meeetings will also be held. The officers of the association are: President, Richard Valentine Janesville; vice-president, H. G. Slater, Waupaca; secretary-treasurer; H, C. Winter, Madison.

The Greenleaf telephone plant of Blue Rapids, Kan., owned and operated under the direction of Dr. A. Armstrong, of Greenleaf, Kan., has been sold to the following stock company: President, Rev. Joseph Miksovskey; secretary and manager, W. R. Lea: treasurer, Joseph Lorence. Directors, the above mentioned gentlemen and Frank Dabrovalong and William Schmercheck. The company has incorporated with $15,000 under the name of the Blue Rapids Telephone Company. This plant has only been in operation a little over three years, but it is said to be the most progressive and complete in every detail in that part of the State.

The Haskell Telephone Company, of Haskell, I. T., capitalized at $10,000, has been formed with J. C. Scully, C. E. Henson and W. J. Criswell, of Haskell, and Earl G. Hopkins and George Whidden, of Boynton, as the incorporators.

Stockholders of the Nicollet County Telephone & Telegraph Company have voted to purchase for $35,000 the St. Peter, Minn., telephone system of James Bennett, and the deal will be closed December 15. The St. Peter system operates exchanges in St. Peter and Kasota and owns 43 miles of lines.

The long-distance line of the Central Dakota Telephone Company has now been constructed to Geddes, S. D. The company has a local exchange at Platte and is being rapidly extended to other towns in that part of the State.

A municipal telephone station system will probably be installed in Hot Springs, Ark. The matter has been considered by the mayor and council, and convenient stations for boxes picked out, which will connect headquarters with all parts of the city by 'phone. The new equipment will be installed by January 1.

The telephone company at Jacksonville, Tex., is experimenting with 'phones to farms near there. The first line has about 16 subscribers and is six or eight miles long.

The Ashland, Neb., Telephone Company has been reorganized, the controlling interest being now held by H. A. and E. A. Wiggenhorn.

The Utah Independent Telephone Company recently opened its Ogden exchange, which has nearly 900 subscribers and 25 operators.

The Twin City Telephone Company of Minneapolis and St. Paul, Minn., an Independent concern, has 12,923 telephones in operation.

The Independent Telephone Company of Topeka, Kan., is installing a new 500 'phone switchboard.

Interstate Independent Telephone Convention.

The annual convention of the Interstate Independent Telephone Association of America is now in session at the Auditorium Hotel, Chicago.

The programme for the first day, Tuesday, December 13, included the reception of members and friends by the executive committee and officers at the secretary's headquarters, the president's annual address, Hon. Henry A. Barnhart, Rochester, Ind., report of the secretary, E. M. Coleman, Louisville, Ky., and the committee reports.

Many interesting papers will be presented December 14 and 15.

Telephone for Mutual Convenience.

The Inter-county Telephone Company, with a paid-in capital of $2,000, has been organized in Huntsville, Ala., and is establishing a system of telephones for the convenience of the stockholders.

The stockholders are all planters residing in the southern part of Madison and Morgan Counties, and they propose to increase their capital to $20,000 in a short time and build lines to several other towns in that section. The telephone system will be operated for mutual convenience more than for profit.

Articles of incorporation have been filed with the Nebraska Secretary of State by the Jansen Telephone Company. The new company has a capital stock of $10,000, and is incorporated by J. E. Grebe, John Nider, John Bevans, William Gerner, Henry Siebe, Henry Fitte, John A. Friesen, B. F. Knapp, Peter J. Thiesen, D. B. Thiesen, J. G. Friesen, Louis Glebe, D. A. Friesen and Jacob Bartel.

Telephone rates at pay stations in Boston, Mass., proper, have been reduced from 10 to 5 cents per call, a notice to this effect being posted at pay stations in the main, Tremont Oxford, Back Bay, Haymarket and Richmond exchanges.

The Citizens' Telephone & Telegraph Company of Kenosha, Wis., an up-to-date Independent company, has only been in operation about 10 months, and has 1,000 subscribers. The list is growing at the rate of 100 a month.

A report from Chester, Pa., states that telephones are being installed in all the toll-gates along the Chester pike. The instruments will be open for public use and will be equipped with automatic coin boxes.

The Home Telephone Company of Clarksville, Tex., capitalized at $25,000, purposes to purchase, construct and operate telephone toll lines and exchanges. The incorporators are John B. King, N. P. Doak, and Hiram Glass.

The Great Bend, Kan., Telephone Company has completed a toll line south to Seward which connects with Stafford, thus reducing the charges to the latter place from 60 cents to 25 cents.

It is stated there is one telephone for each 10 people in Elgin, Ill.

Plans Telephone System for City of Mexico.

Jose Sitzenstatter, who recently obtained a concession from the Mexican Government for the installation of a new telephone system in the City of Mexico, has gone to Stockholm, Sweden, to confer with L. M. Ericsson & Co., of that city, who are to finance the enterprise. The terms of the concession require that work must be commenced on the new system within six months from November 1. Mr. Sitzenstatter intends to spend about two months in the work of studying the telephone systems of the Polish and Russian cities, and he hopes to be back in Mexico City by February 15. It is expected that as soon as he returns to Mexico the preliminary steps for the installation of the new telephone plant will be taken.

The Fulton, N. Y., Telephone Company has decided to enlarge and improve its present system, to meet the demands of the numerous applicants, whom it is unable to accommodate at present. The services of A. J. Kennedy, of Watertown, have been secured to act as supervising engineer of the work. Mr. Kennedy has had large experience in the telephone business, having been assistant manager of the Citizens' Telephone Company of Watertown for some time. The work of improving the system will include a new line of cables throughout, new and larger switchboard, new automatic telephones and many other minor changes.

All the important difficulties in securing rights of way for the new Pittsburg & Allegheny, Pa., telephone line to Wheeling, Va., in connection with the National telephone system, have been settled satisfactorily, and the line has been completed from Wheeling to Bridgeville. The work from Bridgeville to Pittsburg will be hurried and it is expected that inside of a month the line will be in operation.

Workmen have lately been placing an underground telephone trunk line through Elizabeth, N. J., which will connect New York and Philadelphia.

The Valley Telephone & Telegraph Company of Brown County, Wis., has filed an amendment increasing its capital stock from $200,000 to $250,000.

The New York State Independent telephone meeting will be held in Albany next June.

The New Riverpoint, R. I., Telephone Exchange was lately opened.

Telephone Incorporations.

The Long Island Central Telephone & Telegraph Company, Jamaica, N. Y. Capital stock, $5,000. Incorporators: E. H. Snedeker, Jamaica; C. A. Mathews, Brooklyn; C. M. Hewlett, Rockville Center.

The Selective Signal & Telephone Manufacturing Company, Sycamore, Ill. Capital stock, $100,000. Incorporators: James G. Joslyn, Ed-Edward F. Buell and Charles A. Bishop.

The Woodlake Rural Telephone Company, Woodlake, Minn. Capital stock, $30,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

American Fork, Utah.—The Utah County Light & Power Company is arranging to install an electric light and power plant, 1½ miles above its present plant. The estimated cost is $150,000.

Anderson, S. C.—The Piedmont Electric Company of this city has been incorporated with a capital of $25,000. E. S. Moorer is president.

Clarksville, Ia.—The electric light plant here has been sold to Willis Sutcliff.

Clifton, Tenn.—The construction of an electric light plant here is proposed by F. A. Mansfield.

Charlestown, W. Va.—The Harper's Ferry Electric Light Company is now making preparations to supply the town of Brunswick, six miles down the Potomac River, with light.

Colonial Beach, Va.—The Colonial Beach Electric & Power Company has been incorporated here with a capital of $10,000, by Warren S. P. Comba and E. F. Ninde. The company will conduct an electric light business.

Dallas, Ga.—The Dallas Light & Power Company has been formed with a capital stock of $5,000 to erect an electric light plant. A. J. Cooper is president, and E. H. Robertson secretary.

Grand Rapids, Mich.—R. H. Opdyke, civil engineer, is at work on a plan for a dam and power house on White River to furnish power for electric lighting for Whitehall and Montague.

Greenville, Tex.—It has been decided not to sell the electric light plant, as at first considered, but to borrow $10,000 to improve it.

Griffin, Ga.—The city is planning to extensively improve its electric lighting plant.

Halifax, N. S.—Mr. Linn, C. E., a resident of Redford, is interesting himself in a proposition to provide electric lights for that village.

Homestead, Pa.—A deal was lately closed for the purchase of the Homestead electric light plant by the Dawson Manufacturing Company from T. W. Brockman, for $13,500.

Leon, Ia.—This town has voted to sell the electric light plant to W. S. Curtis and H. E. Chase, who will make many improvments to it.

Mackinaw, Ill.—At a meeting of the board of trustees of this village the franchise for the new electric light and water company was granted. It is proposed to locate the new plant near the Vandalia Railroad.

Mountain Lake Park, Md.—It is reported that F. F. Martin, of Fairmont, W. Va., has purchased, and will improve and operate the local electric light plant.

Pocahontas, Ark.—S. D. Dorrell, of Walnut Ridge, and associates, have definitely decided to erect a $25,000 electric light plant.

Richland, Ga.—It is rumored that the city will vote on the issuance of bonds for the construction of waterworks and an electric light plant.

Rock Island, Ill.—The People's Power Company has increased its capital stock from $600,-00 to $1,000,000, and plans to build an addition to its light plant at Moline. A 25,000 hp. generating engine will be purchased.

Story City, Ia.—This city has entered into a contract which will eventually end in the purchase of the electric light plant by the city.

Tarboro, N. C.—The municipal electric light plant here was lately destroyed by fire, causing a loss of $3,000.

Valley Stream, N. Y.—The Queens-Nassau Electric Light & Power Company, capitalized at $100,000, has been incorporated here. The directors for the first year are G. T. Swinnerton, New York; A. Foshay and R. K. Thompson, Brooklyn.

Vicksburg, Miss.—W. O. Crumpler has applied for a franchise to construct an electric light plant here.

Wichita, Kan.—An ordinance granting an electric light and heating franchise to H. G. Landis, has been submitted to the council.

Whigham, Ga.—The town council is now at work preparing to furnish the citizens and streets with electric lights.

Wrentham, Mass.—Payson Bennett has a plan to light the streets of the center of this town with electricity, and in furtherance of this plan he is arranging to harness the water privilege near his residence and install an electric lighting apparatus. If a sufficiency of power can be secured it is the intention of Mr. Bennett to endeavor to light the streets by electricity, and to have this improvement added before the coming of the summer colony.

STREET RAILWAYS.

Battle Creek, Mich.—It is stated that the Michigan Central Company will convert its branch road running from this city, south through Sturgis to Goshen, Ind., into an electric line.

Bradenville, Pa.—A charter has been granted to the Bradenville & Derry Street Railway Company with a capital stock of $36,000, to build a six mile electric railway from Latrobe to this place, Snydertown and Derry.

Connersville, Ind.—Local promoters are interested in a proposed electric line from Cambridge City to this place.

Greenville, S. C.—A company has been formed with $2,000,000 capital to construct an electric railway between Atlanta and this city.

Houston, Tex.—It is stated that the plan for an electric road from Beaumont to Port Arthur, thence to the oil refineries, is to be revived and the road built as soon as the arrangements can be made financially.

Jackson, Miss.—Hon. Wirt Adams is president of the company that proposes to build an electric interurban line from this city to Vicksburg.

Laurel Springs, N. J.—The long-looked-for trolley road through this place is now in sight. Assemblyman Theodore B. Gibbs, owner of the lake and surrounding property, has given the Camden & Suburban the right of way.

Muncie, Ind.—The number of capitalists who have been contemplating the construction of many electric lines in this State for some time have decided to start the work in the spring. They have formed an organization with a capital stock of $3,500,000 and will prepare for the furthering of projects within a short time. It is expected that the preliminary work will be completed for actual construction by early spring. One of the lines included in the list is that of Muncie to New Castle, promoted by E. T. Ice.

Raleigh, N. C.—The Raleigh-Durham Passenger & Power Company has been chartered to construct an electric railroad between this city and Durham. The capital stock is $125,000, W. J. Neims is one of the principal incorporators.

Shamokin, Pa.—Members of the Shamokin & Edgewood Electric Railway Company are about to build a trolley line from here to Sunbury. They have already looked over the field and active operations will be commenced at once.

St. Mary's, O.—G. M. Saltsgaber, of Van Wert, has been here attempting to interest local capitalists in an electric line from Van Wert to this city by way of Venedocia, Converse, Monticello and Kossuth, the same to connect with the Ohio Cantral in this place.

Waterloo, Ia.—Two new electric lines will in all probability be constructed into this city during the coming building season. One is the extension of the Smith Dows line from Iowa City to Cedar Rapids on to Waterloo. The other is the line that was proposed last summer from Marshalltown to this city. The Waterloo, Cedar Falls & Northern Railway Company is also planning an extension of its line from Sumner to West Union, a distance of over 30 miles.

POWER PLANTS.

Batesville, Ark.—The Batesville Power Company has been incorporated with $10,000 capital to develop water power and transmit same electrically for manufacturing purposes.

Canton, Ga.—F. P. Burtz, P. P. Du Pree, of this city, A. J. Warren, W. A. Carlisle, of Gainesville, have incorporated the Etowah Light & Power Company with a capital of $10,-000 to develop water power and transmit same by electricity.

La Grande, Ore.—The La Grande Electric Company has consolidated with the Cove Power Company, and incorporated under the name of the Grand Ronde Electric Company. Walter Pierce, J. A. Thornson and T. H. Crawford are the incorporators. The power plant will be greatly enlarged.

BIOS WANTEO.

Boston, Mass.—The John Davis Company, of 54 North Washington street want a cross compound vertical engine about 2,000 hp. State conditions and price.

Red Springs, N. C.—B. W. Townsend, of this city, wants machinery and equipment for an electric lighting plant to light a town of 1,000 inhabitants.

Washington, D.C.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until December 20 for furnishing various navy yards with electrical material as follows: New York Yard: Insulating tape, steel conduit, etc., Norfolk and Charleston Navy Yards: Arc and incandescent lamps, circuit breakers, motors, switchboard panels, cabinet and panel boards, dynamo, cable recording wattmeters, and miscellaneous electrical supplies. Pensacola, New Orleans and Key West Yards and stations: Miscellaneous electrical material. Blank proposals and detailed information will be furnished intending bidders upon application to the Bureau or to the Navy pay offices in the cities mentioned.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 14¾@15c.; Lake 14⅞@15⅛c.; casting, 14½@14¾c.

Brooklyn Rapid Transit has sold an additional $7,000,000 of its convertible bonds, making the amount outstanding $15,000,000.

The General Electric Company has declared the regular quarterly dividend of 2 per cent., payable January 14 to holders of record December 17.

The Boston & Worcester Street Railway Company has applied to the Boston Stock Exchange to list 24,936 preferred and 25,114 shares of common stock.

The United Traction & Electric Company of New Jersey has declared a dividend of 1¼ per cent., payable January 2. Books closed December 13 and reopen January 3.

Judge Grosscup is quoted as saying that he positively knows that the transaction by which Chicago will have one amalgamated street car system will be completed in the not very far future.

The Twin City Rapid Transit Company has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable January 2. Books close December 17 and reopen January 3.

An examination of the franchises and legal status of the United Railways & Electric Company of Baltimore is being made by a New York syndicate, as preliminary to a proposition for purchase of control.

The New York State Railroad Commissioners have approved the issue of a mortgage of $1,500,000 by the Syracuse, Skaneateles & Moravia Electric Road on condition that not more than $500,000 in bonds be issued without further application for authority.

Under the proposed reorganization of the New Hampshire Traction Company, out of a total outstanding issue of $6,900,000 bonds all but $370,000 have been deposited. Bondholders received 50 per cent. in preferred stock and 50 per cent. in common stock for their bonds.

The Michigan Light Company, with an authorized capital of $2,250,000, to construct and operate heating and lighting plants, was incorporated at Trenton, N. J., on Monday. Incorporators—Walter B. Mahoney, Walter Thiele and Charles N. King, all of Jersey City.

The Metropolitan Street Railway Company of this city announces that, pursuant to a resolution of the board of directors, it will pay a quarterly rental of 1¾ per cent. upon the capital stock of the company, to be received from the New York City Railway Company on January 16.

The Supreme Court of the United States on Monday decided the case the Western Union Telegraph Company vs. the Pennsylvania Railroad Company, involving the right of the railroad company to remove the telegraph company's poles from its right of way, in favor of the railroad company.

The United Railways Investment Company of San Francisco has just declared a dividend of 2 per cent. on its preferred stock. This is an increase of ½ of 1 per cent. over the dividend paid in July last. The first dividend on the preferred stock of the company was 1½ per cent., paid on January 3, 1903; in July, 1903, 1½ per cent. was paid, and in January, 1904, 1½ per cent. was disbursed. The dividend just declared is payable January 3. The company's preferred stock books will close December 19 and will reopen January 3.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Dec. 12.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	163½
Metropolitan Street Railway	118½
Metropolitan Securities	77
Ninth Avenue	197
Third Avenue	130¼
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	67½
Public Service Corporation (New Jersey)	135
Philadelphia.	
Consolidated Traction of New Jersey	77¼
Philadelphia Traction	98½
Union Traction	59⅛
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	14
do. do. do. pref.	62
West End Street, com	92½
do. do. do. pref.	113
Chicago.	
City Railway	186
North Chicago	76⅛
Union Traction, com	11½
do. do. pref.	43
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16¾
do. pref.	68
Electric Boat, com	40
do. do. pref.	70
Electric Lead Reduction	½
Electric Vehicle, com	17
do. do. pref.	23
Westinghouse, com	178½
do. pref.	192
General Electric	183
Boston.	
Edison Electric Illuminating	253
General Electric	183½
Westinghouse Electric & Mfg., com	93
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	45
do. do. pref.	110
Philadelphia.	
Electric Company of America	10
Electric Storage Battery, com	81
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	148
Western Telephone Company	20
New England Telephone Company	140
New York.	
American Telegraph & Cable Company	93½
Commercial Cable Company	210¼
Mexican Telephone Company	2¼
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92
Miscellaneous.	
Chicago Telephone Company	123
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	47
Consolidated Car Heating	64
Standard Underground Cable	200

ELECTRICITY.

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CONTENTS.

EDITORIAL NOTES.

The Daily Papers and Kilowatt Hours.

Dean Swift's sally regarding the inventors who try to extract sunshine from cucumbers, is a statement not entirely lacking in common sense. A New York paper has been agitating editorially for the past few days for the erection of a city plant, which by burning city debris, will produce enough electricity to light the great cosmopolis.

City refuse frequently proves expensive to burn. The claim of from 30 to 80 kilowatt hours per ton of refuse consumed, are alluring figures. With 5,500 tons of refuse per day from which to obtain power more than 165,000 kilowatt hours would be obtainable. We use now, 22,600 kilowatt hours per day for street and public lighting, which should be doubled to give enough light in side streets.

The possible source of power from refuse is four times the actual necessity at present. We are paying more than $350,000 annually to have this stuff modified to serve as filling for Riker's Island.

We are certainly an extravagant municipality, if these figures are correct. Mix a little coal with refuse, and it burns cheerfully. Lighting New York City brilliantly at night in every quarter would effectively dislodge crooks and sneak thieves. To eradicate crime by the intelligent application of city refuse, is a proposition almost nerve-shattering to our well-known sociologists. It is true that in all evil there is good, and the one-time curse of cities bids fair to become its greatest blessing. Although the "New York Times" has just discovered this new engineering situation, it is now almost old. A daily paper, however, can drive a fact home—into the public mind better than the technical press. And it may also be added, though as a reproof it would not touch the dead and buried Swift, that the imaginative flights of some of our best litterateurs often prove to be solemn facts.

* * *

Some Mistakes in Power Plants.

America is the home of great power plants; it is also a country in which many small power plants are installed. The demand for electricity for light and power is so great and so insistent that every available source of energy of this character is utilized wherever possible. Averaging up the great list of installations, both great and small, it will be found that the standard is high and the machinery modern. But there are a few isolated instances where criticism must be made, because of the shortsightedness shown, or, to be more charitable, the haste shown in building plants of an unsuitable character in unsuitable places. To realize the nature of some of these mistakes in power plant construction and site of installation, take the general case, such a one perhaps as is most likely to occur in a semi-mountainous district—a district such as would be found in certain parts of Ulster County for instance. Here, we find mountain torrents and in their nearby vicinity blossoming villages, or to dignify them more correctly, small townships. In these miniature cities a high municipal spirit prevails and the ambition of the community, when examined and understood, is to possess, so to speak, "the gifts the gods offer." They desire to bond themselves so as to enjoy the pleasures of electric lighting, telephones and trolley cars. What is the result? If a small cascade pours over the edge of some contiguous eminence the possibilities of a power plant loom up in large

and wholesale measure. The enterprise, if municipal, is put through and the machinery installed. It does not necessarily follow that if the funds are collected from private sources the results would be very different. In this case a franchise is probably granted by the proper authorities for arc lights, incandescent lights and a trolley line. If the installation is completed and operates successfully there is, of course, nothing to be said. But, in an instance of this kind, much was said when the icy grasp of winter throttled the mountain stream, choked it with snow and ice, and withheld from the turbines their customary quota of kinetic energy. In such a case as this, and it may be said that these incidents represent the real experiences of a very enterprising little center not many hours from New York, the only recourse left is to install steam engines and boilers, and cart up fuel to tide over such gaps in the steady supply of power. Bringing fuel up a mountain side has always been considered an expensive process, yet, when such circumstances prevail as those cited, the pill must be swallowed. A lesson is learned which a little reflection would have surely taught beforehand—that mountain torrents freeze in winter.

A steam plant is therefore necessary, and this, when perched high up in the air, is an everlasting trouble and expense. The moral is, that it is sometimes cheaper to use steam in or near a township than steam and uncertain water power several miles away. False economy is the *ignis fatuus* of small communities—the penny wise and pound foolish idea of ill-advised investors.

* * *

Methods of Getting Foreign Trade.

The methods necessary to get our share of foreign trade continue to be seriously discussed by electrical manufacturers, the question how they can meet foreign competition being the vital one in this regard. The answer is simple. By conforming to the wants of the customers in foreign countries equally, or as well as do the Europeans; in other words, by giving the foreign people what they want, and not what our manufacturers believe to be best for them.

The best and easiest way to get into the foreign markets is to send expert agents, armed with samples where possible, but these agents must be more or less familiar with the language and customs of the people whose trade is desired. In sending out letters, circulars, catalogues, etc., our exporters should give just such information as a firm or exporter would want were he to receive a letter of inquiry or a catalogue. What would an American dealer do with a catalogue that came to him in a language he could not read? In most cases he would consign it to the waste basket. The manufacturer who has anything to sell at home sends out his best men to canvass the country to be covered. Why expect success abroad on any less sensible lines?

A great deal of extra work must be expended in the foreign field before an entrance is effected. This is natural, for conservatism is characteristic of all peoples. Before a beginning is made the office of the American electrical exporter ought to be familiar with the freight rates, the tariffs, the methods of transportation, packing, the financial methods, terms of payment, discounts, banking facilities, etc., to and in the country whose trade is sought. The exporting house should be ready to quote prices f. o. b., c. i. f., etc. It should also be ready to tell parties just what they will have to pay under the different methods, and it ought to be ready to give the foreign customer his choice in regard to shipping, payment, etc. Packing is one of the most important factors in foreign trade. What will do for Europe is entirely out of the question in South and Central America, Africa, and parts of the East. What might do for the coast ports of Peru, Argentina and Brazil might be unsuited for places inland.

Organization is nowhere more necessary than in our efforts to extend foreign trade. The method of arranging a bureau or department to which the duty of dealing with the foreign trade is assigned, should accord with the methods employed with the well-established rules of successful houses following the same or similar lines. The office machinery at both ends should be the very best. The work is one that calls for the closest attention and the highest intelligence. To sum up the whole situation, the way to develop trade abroad differs very little from the methods employed at home. The growing endeavors to increase our export trade in electrical machinery and appliances shows that our manufacturers are awake to their opportunities, and are beginning to appreciate that the foreigner cannot be treated carelessly and without consideration, if they wish to make his custom a factor worth considering in their business.

The National Electric Light Association has just issued a report on thawing water pipes by electricity. The report is compiled by Mr. George S. Haley of Rutland, Vt., and comprises data received from 75 different companies who have already had experience in this direction. The report will be gladly welcomed by those members of the association located within the frost belt.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Mr. Alexander E. Orr, president of the Rapid Transit Commission of New York, says four new subways are now assured for this city.

The first wireless telegram, a special cable dispatch announces, has been sent from Cornwall to Italy over the Alps without a mistake.

The Nobel prize for physics has been awarded to Lord Rayleigh, professor of natural philosophy of the Royal Institution; and for chemistry, to Sir William Ramsay, professor of chemistry of the University College, London.

It is reported that Corporation Counsel Delaney of New York will deliver to the Board of Estimate before the Christmas holidays his draft of a bill to be sent to the Legislature, to give the city needed power to construct a municipal lighting plant.

At the annual two days' meeting of the electrical committee of the Underwriters' National Electric Association, recently held in New York, the tendency was toward a simplification of the rules, eliminating as far as possible in the matter of detail and method of construction, placing the code instead on a broad plane. A number of minor changes were made to the rules and some explanatory foot notes added.

Projects for Swiss mountain railways do not rain but pour. A concession has been granted for a line to start from Meyringen and proceed by way of the Grinsel to the Rhone Glacier. It is to be an electric line, water power being abundant. The scheme is for the moment in abeyance, pending the result of an opposed application for a concession from the Canton of the Valais for a supplementary line connecting the Rhone Glacier with Brieg. The delay, however, is not likely to be long; and presently, when the Simplon Tunnel is open for traffic, we shall see the Italian cheap-trippers joining the German and English on the Oberland, already overcrowded.

REGISTERING ATMOSPHERIC CHANGES BY WIRELESS TELEGRAPHY.

BY A. FREDERICK COLLINS.

The method of sending and receiving signals and messages by wireless telegraphy is well known, but there are numerous other instances in which the action of electric waves have been made to serve useful purposes.

Among these are devices designed by Emile Guarini Foresio, of Brussels, Belgium, who invented the automatic wireless telegraph relay; E. Ducretet, the Parisian instrument maker; Dr. Thomas Tomassini, a physicist of Intra, Italy, and Prof. Eduard Branly, of the Paris Catholic University and the original inventor of the coherer.

As all of these have to do with temperatures and electrical pressures a brief description of Guarini's wireless fire-alarm signaling apparatus may be found interesting. In this arrangement an ordinary wireless telegraph transmitter, including the induction coil, spark-gap and aerial and earthed wires are used, but instead of a telegraph key to arbitrarily make and break the circuit an automatic apparatus is provided for indicating the position and number of a burning building.

For this purpose a thermometer has a leading-in wire of platinum which connects with a column of mercury; the opposite wire is sealed in the upper end of the tube at a point where any undue heating of the tube would send the mercury into contact with it. The wires are now connected in circuit with a battery and an electromagnet; the armature of the electromagnet operates a lever which checks or releases a disk, as the case may be. The disk has notches cut in its peripheral surface, representing numbers, and when released by the armature of the magnet, due to the closing of the circuit by the rise of the mercury in the tube, it is revolved by a small spring motor and makes and breaks the circuit of which the induction coil forms a part, according to the number and position of the notches. The number of the burning building is indicated at the fire engine house by the received electric waves and the impulses imprint the number on the tape by a Morse register, just as though wires joined the instruments instead of thin air.

Another simple though ingenious contrivance is Ducretet's scheme for the distribution of time by telegraphy without wires. Here again the regulation transmitter is employed at the observatory and at stated intervals an operator telegraphs the word "time." Throughout the city of Paris watchmakers have small receivers installed, consisting of an auto-coherer and a telephone receiver and by placing the latter to their ears they are enabled to hear certain characteristic clicks, due to the impinging electric waves, and so may ascertain to the one-hundredth of a second the correct time.

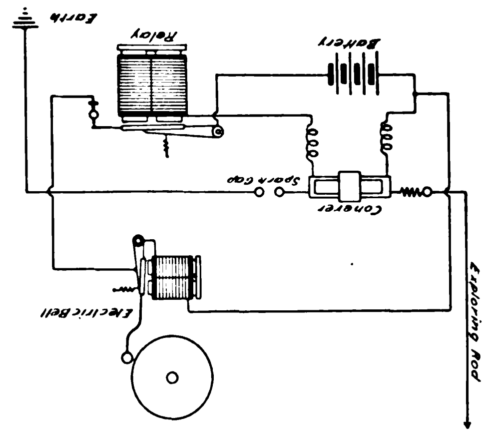


FIG. 1.—POPOFF'S DETECTOR FOR ATMOSPHERIC ELECTRICAL CHANGES.

The first efforts to utilize electric charges for the study and indication of meteorological conditions was made by Prof. Popoff of the Crondstadt Military School of Russia, and who communicated his method to the Physico-Chemical Society of St. Petersburg in 1895. Prof. Popoff's apparatus is shown in the diagram, Fig. 1; it comprised an aerial wire elevated several meters above the top of the building and was termed by the inventor an exploring rod; this was connected to a coherer fashioned after the original one designed by Branly which was withal a very crude device. The opposite side was connected to a wire leading to earth through a small spark-gap.

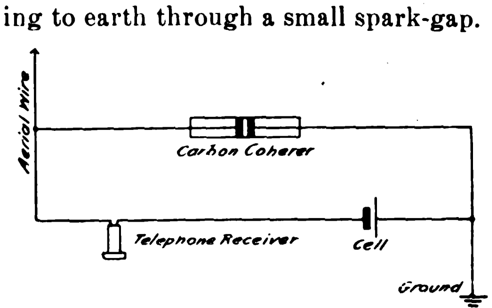


FIG. 2.—TOMASSINI'S METEOROLOGICAL DETECTOR.

Opposite sides of the coherer were connected to a battery and a relay which, when in action closed a shunt circuit formed of the magnet coils of a bell, the hammer of the latter serving not only to ring the bell but also to tap the coherer and thus restore the filings to their normally high resistance.

As there is always a greater or lesser difference of potential between the upper layers of air and the earth immediately underneath, the idea of the physicist was that when these potential differences reached a certain maximum critical value the filings would cohere and ring the bell. By this extremely simple method a curve could be plotted that would show at what hour of the day or night these electrical disturbances took place.

From 1895 to 1900 much was learned concerning the action of electric waves and many improvements were made in the construction of the coherer. Thus it was ascertained that when grains of carbon were used instead of nickel and silver filings, after they had been cohered by electric waves, they would be restored automatically and that the tapper could therefore be dispensed with. This also did away with the relay and bell and reduced to a minimum the inertia of mechanical appliances.

In Dr. Tomassini's arrangement, Fig. 2, these points were carefully considered and the apparatus provided by him consisted only of an auto-coherer, formed of carbon granules and having a wire extending upward and another leading to earth, as in Prof. Popoff's experiments. The internal circuit was formed of the auto-coherer, a single dry-cell and a telephone receiver connected in series. This proved to be a marvelously sensitive instrument.

To make the apparatus as compact as possible the doctor inclosed the coherer in the telephone receiver and to this combination he gave the name of electro-radiophone for the reason that it indicated radiations in the form of electric waves produced by electric discharges of near or distant storms by converting such radiations into audible sounds.

Now instead of merely being able to ascertain differences of potential the doctor was enabled to receive electric waves as in wireless telegraphy, for there is a characteristic difference in the sound produced by the diaphragm of a telephone receiver when the coherer is affected by atmospheric potential differences, and electric oscillations set up in the aerial wire by electric waves.

As an illustration of the vividness of the operation of detecting storms by the electro-radiophone before there was the slightest visual evidence of it a single case, which was often repeated, may be cited. The morning of a September day had been bright and clear but the meteorological telephone had begun by making low noises and showing clearly that there were feeble electric waves that had found their origin a great distance away; these kept on multiplying in number and

ncreasing in loudness until about noon when the sounds very accurately reproduced the prolonged roll of thunder. By two o'clock the horizon became flecked with clouds and as these came nearer flashes of lighting could be seen, although the thunder was yet without the hearing of the unaided ear.

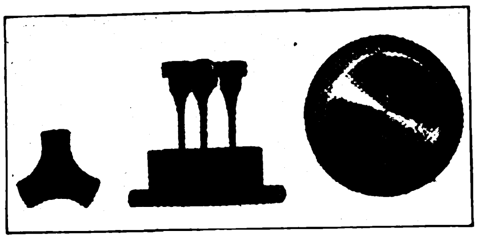


FIG. 3.—THE COHERER.

As the storm grew closer, the sounds in the telephone changed to a crackling noise, when a moment later rain began to fall. Not forgetting the fate of a Russian philosopher, who was seeking to verify Franklin's experiment of identifying lightning and electricity and was instantly killed by a bolt, the doctor wisely removed the connections, and none too quickly, for a blinding flash and terrific crash struck the earth in the immediate vicinity of his laboratory and a moment later a flood of water fell in torrents. Dr. Tomassini was enabled to make quite accurate predictions twelve hours in advance, and, as he has pointed out, by following their courses, seamen might often be able to save themselves, if they adopted this method.

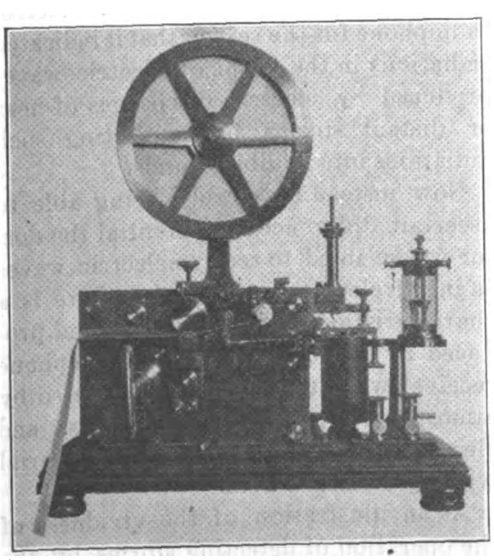


FIG. 4.—POPP-BRANLY WIRELESS TELEGRAPH SYSTEM.

The most recent improvements in the new art of meteorological wireless signaling is due to Prof. Branly and M. Victor Popp of Paris. This is a combination of electric wave receiver and meteorological registering apparatus, which automatically and continuously describes on a chart made of paper any electrical disturbance due either to temperature variation of the atmosphere or to stresses in the ether.

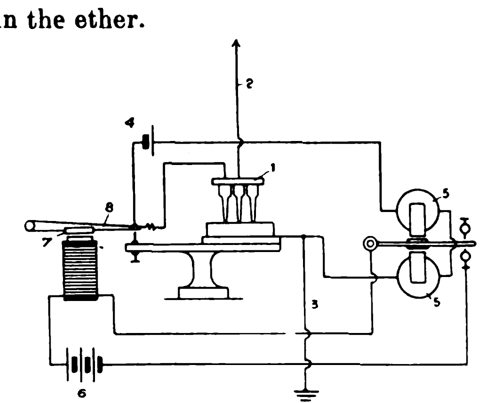


FIG. 5.—POPP-BRANLY WIRELESS TELEGRAPH RECEIVER.

A brief description of the Branly-Popp wireless telegraph receiver which is used in connection with the register will render clear the operations of both. The differentiating feature in the new system is the coherer, which is based on the results of a long line of experiments. The coherer, Fig. 3, consists of an angular metal top having attached to its under surface three small and highly polished legs upon the tips of which a slight deposit of oxide is formed by heating. These legs, each of which tapers to a point, rest on a polished disk of steel.

Prof. Branly ascertained that a very few oxidized points, resting lightly on a bright steel surface, is a great deal more sensitive than a filings coherer, while its action is also much more accurate. The decreased number of contact points also had the advantage of decohering with the slightest tapping and by making use of this knowledge Profs. Branly and Popp evolved the apparatus shown in Fig. 4, which is a complete wireless receiving apparatus except the polarized relay.

The connections are shown in the diagram, Fig. 5 By referring to the photograph and the line drawing it will be observed that the tapper, a prominent appliance in every other system using a tapping back coherer, has been practically debarred, for the coherer occupies a place just to the rear of the Morse register and a lever attached to and projecting from the armature serves to strike gently the stand on which the coherer is placed.

The top of the coherer 1 is connected to the aerial wire 2, while the base leads to the earth through the wire 3; this forms an open circuit for the received waves to set up oscillations in. There are two internal circuits, the first one including the coherer 1, the battery 4 and the relay 5. When the oscillations cohere the legs to the lower plate, the first internal circuit is closed and the relay closes the second internal circuit, the battery 6 drawing down the armature 7 of the Morse register and as this serves to close the first internal circuit the latter is consequently broken, the lever 8 strikes the coherer table, breaking the contact between the legs and the steel disk on which it rests.

In the meteorological apparatus, shown in Fig. 6, the Morse register is not used,

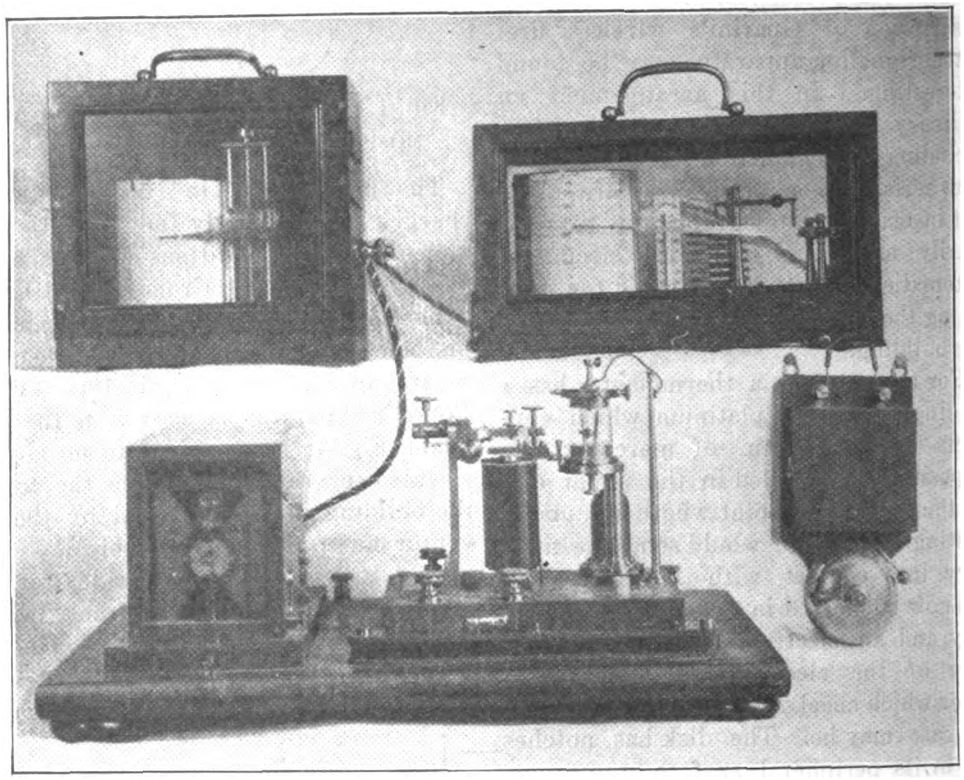


FIG. 6.—APPARATUS FOR ANNOUNCING APPROACH OF STORMS.

but the magnets and circuits just described are still retained, these actuating and operating the long and delicately balanced pointer, carrying at its end a glass pen, which traces every impulse of the coherer upon the chart.

When the impulses become too severe the bell rings out its warning and it is then time to cut out the delicate instruments or suffer the results of a too heavily charged wire.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

BATTERIES.

Zinc as Fuel.—Power is produced in a cell by chemical action taking place between the zinc and acid. As zinc is employed in the great majority of batteries, and as this metal is consumed during the operation of the cell, it must be regarded as the fuel through which the transformation is effected of chemical energy into electrical energy. If during the operation of a cell, the liquid becomes very warm, it is a sign that the processes are not taking place properly, and the energy which should be transformed into electricity is being dissipated as heat.

If zinc is to be regarded as fuel, the battery utilizing it cannot be considered as differing essentially from a steam boiler, whose power in the form of steam under pressure is the result of the chemical processes taking place between the coal and the oxygen of the air.

In finely constructed steam plants it takes from 4.5 to 6 pounds of coal to give 1 hp. for one hour. In a battery it takes from 1 to 2 pounds of zinc to give 1 hp. hour. The reason why the amount of zinc per horse power hour differs, is because the number of volts produced by different cells differ. For instance, it is well known that the number of volts produced by a zinc and copper cell are about 1, whereas the number of volts produced by a zinc carbon cell are about 2. In other words, the elements composing a cell give a number of volts depending upon the character of the elements employed and the nature of the solution. If this is true, then it must be understood that the amount of zinc consumed to produce a current of a given strength is always the same. The exact amount of zinc consumed to give a current of 1 ampere for one hour is 1.2133 grammes. If these figures are turned into the English system, it will be found that the following results are obtained:

Volts of cell.	Horse power hours.	Weight of zinc.
1	1	2 lbs.
1.5	1	1.33 "
1.75	1	1.14 "
2.00	1	1.00 "
2.5	1	.80 "

To test a battery it would be necessary to weigh the zinc plate before and after it has developed a given amount of current for a specified time. If there are marked differences between the figures obtained, and those given in the table, local action will be sufficient to account for them.

Comparing the cost of electricity obtained from batteries with that obtained from electric light plants, the following figures will indicate the impossibility of the former at present competing with the latter. The question is essentially a commercial one, in which the contrasting figures show the costliness of electricity obtained by chemical action in batteries.

Cost of Electricity from Bichromate Batteries.—A solution of sulphuric acid and bichromate of potash of the following proportions, costs about 35 cents a gallon:

Formula: 1 pint water dissolving 3 ounces bichromate of potash; add 2 ounces sulphuric acid.

The cost of the zinc would be about 15 cents a pound, well amalgamated with mercury. On this basis, estimating that one pound of zinc will require one gallon of solution, it is easy to see that the generation of 1 hp. hour would involve the following expense with a 2 volt battery:

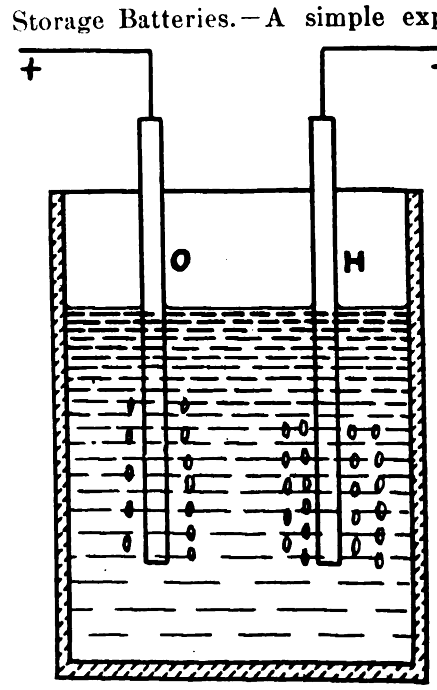
Zinc, 1 lb.	15 cents.
Solution, 1 gal.	35 "
Total	50 cents.

If these figures are compared with the cost of a horse power hour produced in an electric light station, where such power costs about 4.5 cents instead of 50, the ratio between the two is more than 10 to 1 in favor of the dynamo plant.

If batteries are used which give less than two volts, the cost rises until it is seen that any claims to do electric lighting, or to supply power from batteries, are necessarily absurd if the proposition is framed so as to indicate attempted competition with electric light and power companies.

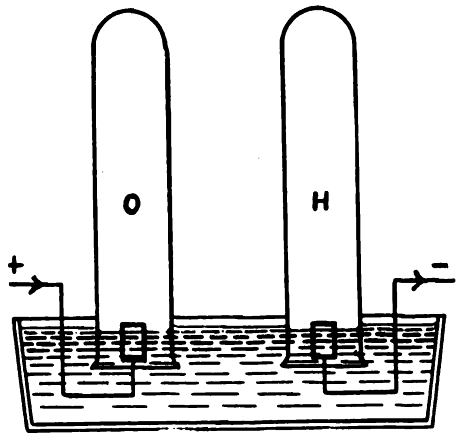
The possibilities associated with the primary battery are very great from a theoretical standpoint. Many efforts have been made to obtain the energy from coal by electrical means without resorting to direct oxidation and combustion. If it were possible to reduce coal, so that while oxidizing it did not develop heat, but electricity, then a great problem would be solved. The amount of energy stored away in a handful of coal is enormous, comparatively speaking. A well-equipped electric light plant is able to get the effect of about 14 pounds of coal out of every 100 pounds consumed. On this basis it is evident that more than seven times the amount of power obtained is wasted through radiation, etc. An electrical method of reducing coal so as to transform its heat energy directly into electricity would represent an enormous saving of fuel and power. The general efficiency of a battery is high in comparison with an electric light plant. When a battery has over 70 per cent efficiency an electric light plant has only 14 per cent. But, as shown by the last figures, the cost of materials consumed is too great. This being the case further progress in the field of battery construction is impeded by a lack of sufficient knowledge to accomplish the purpose in view.

Storage Batteries.—A simple experiment is that of placing the terminals of a battery of cells in acidulated water and noting the bubbles which appear at the positive and negative poles. A close examination will reveal the fact that there are more bubbles at the negative than at the positive pole. The process taking place is thus: The electricity in passing from pole to pole decomposes the water the two gases composing water are oxygen and hydrogen and these gases collect at the two poles. The oxygen appearing at the positive and the hydrogen at the negative pole. There is more hydrogen than oxygen because water when decomposed yields twice as much hydrogen as oxygen.



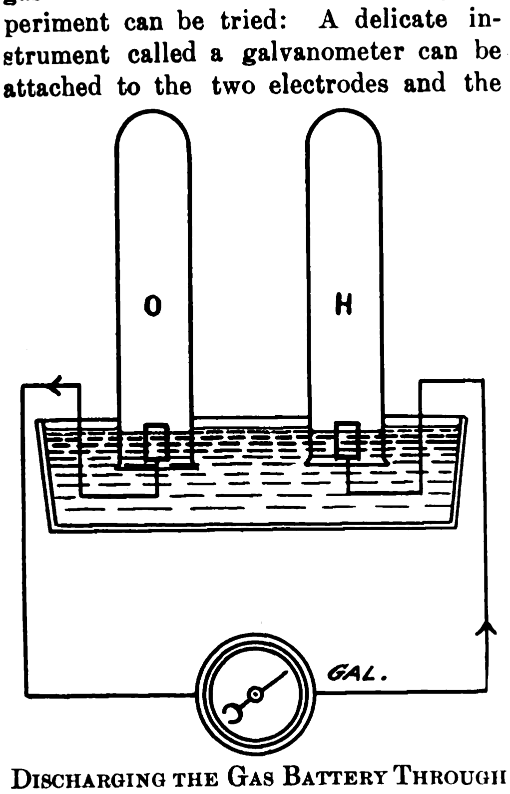
DECOMPOSITION OF WATER.

If tubes are used to collect the gases at the two poles and the said tubes partly dip into the water along with their platinum electrodes; then, when sufficient



COLLECTING OXYGEN AND HYDROGEN IN TUBES.

gas has been collected the following experiment can be tried: A delicate instrument called a galvanometer can be attached to the two electrodes and the



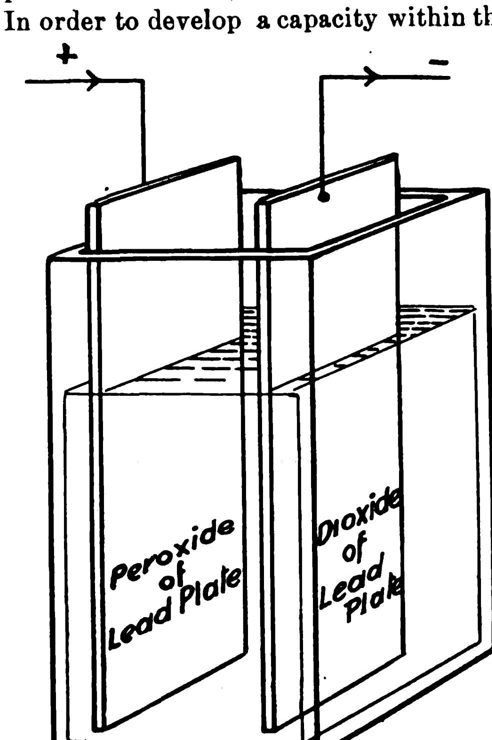
DISCHARGING THE GAS BATTERY THROUGH A GALVANOMETER.

effect of this connection noted. The needle of this instrument will, at the moment of connection, swing from a position of rest and indicate the passage of a strong current. The only explanation of this is by reference to the two gases and the electrodes.

Here is a case of a current appearing, as if this combination of tubes, gases and electrodes with water represented the constituents of a battery. By sending a current into this combination of parts, gases are evolved. It seems that on bringing the terminals from the tubes together, after disconnecting the original source of electricity, a current is returned. This is, in many respects, the first type of storage battery evolved and from which developed many types in common use today.

Plante's Invention.—Gaston Plante may be considered the father of the modern storage battery. He tried the foregoing experiment and then decided to try other metals than platinum for his electrodes. The results obtained by the use of lead plates were so surprising that little if any scientific progress was made in this direction since his day. Lead electrodes when dipped in dilute sulphuric acid and carrying an electric current begin to oxidize. The plate connected to the positive pole becomes coated with a film of peroxide of lead, a reddish spongy development. The other plate, connected to the negative pole, is oxidized to a lesser degree. In this case the coating is one of dioxide of lead, a grayish and less spongy surface. When these oxidized surfaces appear, if the current is stopped and the electrodes connected to a meter or indicating instrument like a galvanometer, a powerful current will be noted.

Treatment of the Plante Cell.—The current will continue to flow from the plates for a while, and then it will cease. In order to develop a capacity within the



LEAD PLATES BEING FORMED INTO OXIDES OF LEAD.

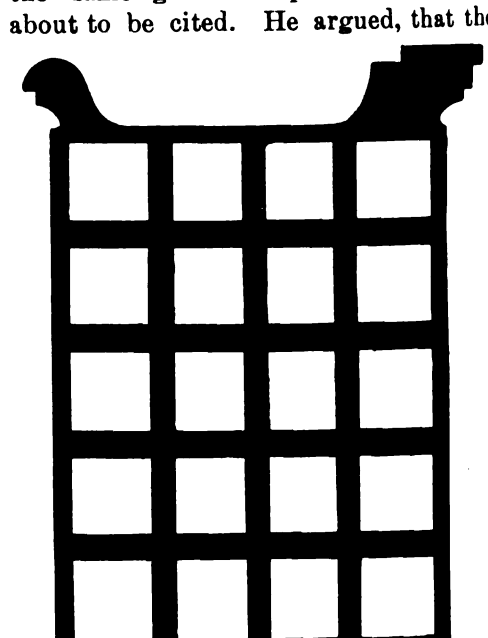
plates for a continued supply of current, Plante found it necessary to "form" the plates. This is accomplished by sending a current in one direction, and then discharging the cell and then in the other direction, and discharging the cell. By repeating this process and lengthening the intervals of charging the plates and discharging them, the so-called forming process is eventually completed. When the plates are formed, they are of a spongy texture, but their capacity has been wonderfully increased. The gases formerly seen at the beginning of the process do not appear. All of the energy applied in the form of electricity, in a theoretically perfect cell, is transformed into chemical energy within the porous and spongy plates of dioxide and peroxide of lead.

Definition of a Storage Battery.—A storage battery, therefore, is one which receives electrical energy, and transforms it into chemical energy and this again into electrical energy when the cell is being discharged. During this process some of the energy is wasted in heat and in decomposing the solution. The dissipation of energy occurs while the cell is being charged and then when it is being discharged. About 30 per cent. of the total power is thus lost.

A storage battery, after it is charged, possesses nearly all of the features of a primary battery.

The gradual transformation of the lead plates into oxides, whose relationship to each other in the acid solution gives rise to a current, makes it clearly evident that the oxides are responsible for the result although they themselves are the direct effect of electrolytic action.

The Inventions of Brush and Faure.—Charles F. Brush in America took out patents on a rather different type of plate from that known as the Plante. Camille Faure, of France, laid claim to the same general improvement as that about to be cited. He argued, that the



THE LEAD GRID TO WHICH PASTE IS APPLIED.

development of the lead oxides on the lead plates through the "forming" process is necessarily a slow and expensive method and proposed hastening it by the

application of lead oxides to the surface of the lead. A red lead paste was originally applied to both plates, and this, by the action of the current, was reduced to the oxides found on the original Plante plate. Eventually a lead grid was invented in the openings of which the oxides were pasted. Red lead paste was applied to the positive and a paste made of litharge to the negative grid. By this means intimate contact was secured between the grid and paste and it became easier to obtain that which is called "an active surface."

Lightness and Capacity.—The pasted grid plate gives both lightness and capacity and thus improves the utility of the storage battery in this respect. For automobile service, as well as for station use, the storage battery has found a distinct field. Its lightness and increased strength, due to the grid form are features of the greatest importance. A weak plate causes the oxide to crack and fall away. A Plante plate is very weak unless reinforced by the use of thick lead. Grids, however, can be made of an inoxidizable material to resist deformation.

Defects of Storage Batteries.—The defects of storage batteries may be classified under the following heads—sulphating and buckling.

The first, sulphating, is due to the plates being left in the acid solution uncharged. The second, buckling, is due to the discharge being too heavy and thus bending or buckling the plates.

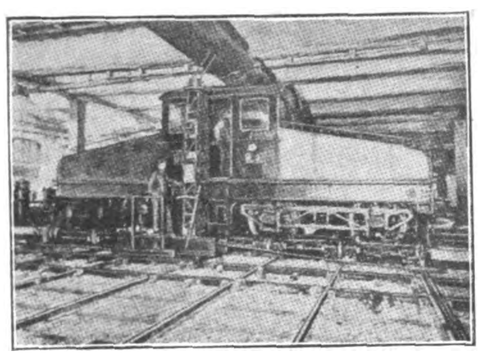
Sulphating is avoided by keeping the batteries charged, never allowing the charge to fall below a certain point. The means for detecting this is to be found in the voltage of the cell. When fully charged its voltage is 2.2 and when being discharged it should not be allowed to fall below 1.9 volts. By adhering to this rule sulphating is avoided. The action of the acid on lead forms a whitish cement-like coating, which consists of sulphate of lead. This can be scratched off with great difficulty or may be eventually transformed into an oxide by continued charging.

A strongly built plate will resist the warping influence of a heavy discharge. The standard types found in the open market are built on these lines and serve the purpose expected of them satisfactorily.

Capacity.—The area of the plates governs their capacity as well as the amount of active material they contain. One cell with twice the plate surface of another cell would have about twice the capacity, other things being equal. Catalogues of the manufacturers of storage batteries ill supply this data, which varies with each particular style of plate. The rating is given in ampere hours, which means a given strength of current for a given number of hours, a greater current for less hours or less current for a greater number of hours.

PARIS--ORLEANS ELECTRIC RAILWAY EXTENSION.*

The Paris-Orleans Railway Company commenced its train service by means of electric traction in May, 1900, at a time when electric railways, if not in an experimental stage, were at all events looked upon from many sides as an expensive



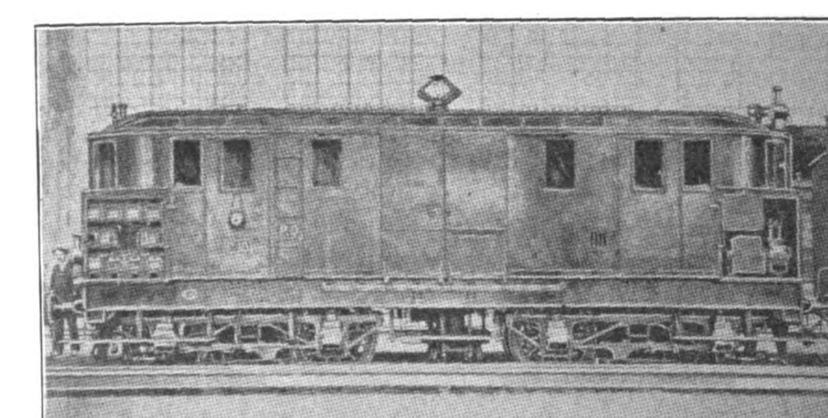
Electric Locomotive, Original Type.

luxury beyond the pale of practical every-day main trunk lines. When the installation was designed, the only similar railways in existence were equipped with small trains for suburban traffic, hardly comparable with the system in question.

The confidence of the Paris-Orleans engineers, however, was such that there was no half-hearted advocacy of the electrical installation, and the design provided that possible extensions could be easily made. The same policy of foresight has characterized the new extension, especially in respect of the provision of apparatus for use on a circuit, the voltage of which will eventually be 11,000, although 5,500 volts is the highest at present in use. The present installation has given the fullest satisfaction to the railway company.

It may be useful to recall the circumstances which led to the adoption of electric traction. Owing to the spread of the city westward, it was necessary to provide a more central terminus in Paris for their main and suburban traffic, and the Orleans Railway Company was fortunate in finding an excellent site on the bank of the Seine, almost a stone's throw from the Chamber of Deputies. The distance from the old terminus of Austerlitz to the new station of Quai d'Orsay is about 2½ miles, and this is mostly in a subway. The new terminus was provided with 15 tracks, converging into two, which continue as far as the old Austerlitz Station. The train service amounted in the summer to as many as 150 trains daily. The most economical solution of the problem would, of course, have been to continue the haulage by steam locomotives as far as the new terminus. This, however, was not found to be possible, ventilation and other difficulties barring the way. Thus the conditions were altogether special, and a comparison of costs of electric traction could only be made with a system of traction by locomotives emitting neither steam nor smoke.

Dealing with the 1900—1904 service, on the average 140 trains have arrived daily at the (old) Austerlitz Station, ranging in weight, exclusive of locomotive, from 150 up to a maximum of 300 tons. These trains arrived at Austerlitz Station behind regular steam locomotives, and an exchange was made (the time required was 2 minutes) from the steam to the electric locomotives, in tow of which they



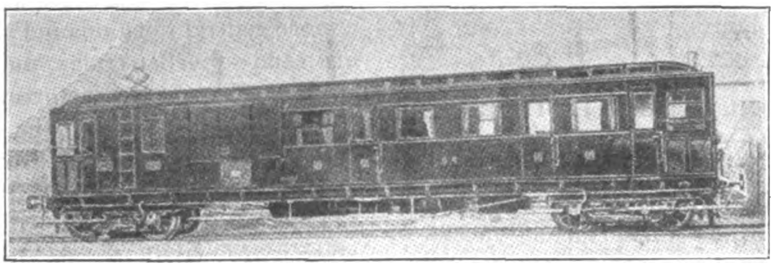
New Type of Loccmotive.

proceeded through the tunnel to the Quai d'Orsay terminus, and vice versa. The distance between the stations is 2.4 miles, and the majority of the trains made a one minute stop at the intermediate station of St. Michel. The electric locomotives drew the heaviest trains between the two termini in eight minutes.

The rolling stock provided included

*From the "Electrical Review," London.

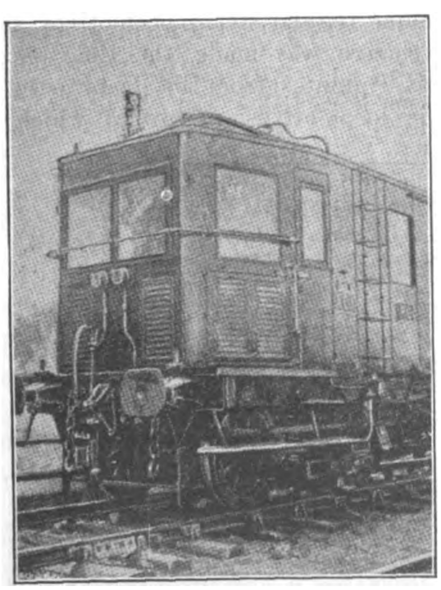
eight electric locomotives, each weighing about 50 tons, and equipped with four 225 hp. motors, one on each axle of the two bogie trucks. The appearance of the locomotive is shown in the accompanying illustration. It consists of a central steel cab with sloping ends, mounted on a channel framework and carried on two swivel trucks of specially heavy build. The principal dimensions are as follows: Length over all, 34 ft. 10 in.; width over all, 9 ft. 7 in.; height above rails, 12 ft. 9 in.; distance between truck centers, 16 ft.; wheel base (each truck), 7 ft. 10 in.; diameter of drivers, 4 ft. 1 in.



Motor Car.

The motors are of single reduction railway type with nose suspension. The gear ratio of 4.1 to 1 was adopted, but this has been altered for the new service, as will be seen later.

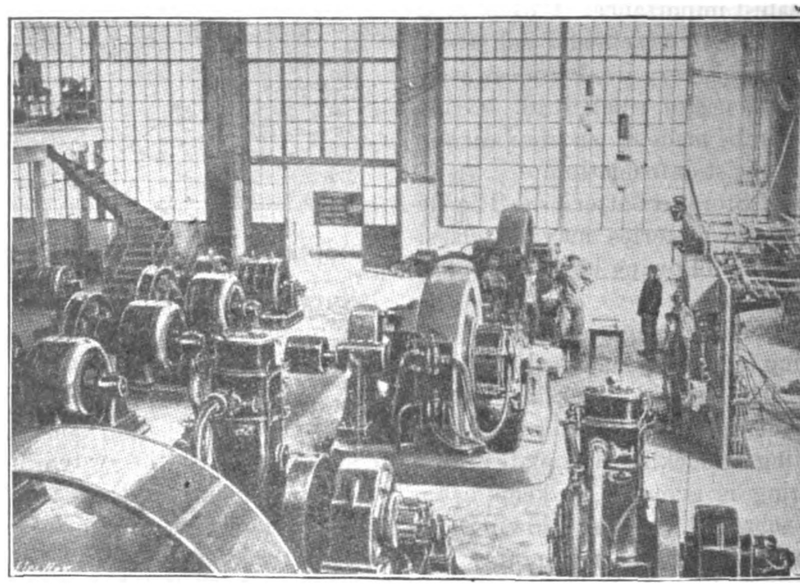
The controller is of the series parallel type. Included in the electrical equipment of the locomotive are the usual air compressors, sanding devices, instruments and switchgear.



End of Motor Car.

The third rail system supplied current at an average pressure of 575 volts (now 600), and the locomotive is furnished with four shoes for contact with the rail, which is situated outside the track. In certain parts of the route the side rails are supplemented by short stretches of center rail, and suitable insulated contacts are provided on the motor frames. At other points, where third rail construction is too complicated, an overhead conductor of inverted "T" iron has been provided, and the locomotive carries an overhead shoe, as seen in the figure.

The generating system included two groups (now three) of 1,000 kw. each, erected at Ivry power station, close to the Austerlitz terminus. The three-phase current is produced at a pressure of 5,500 volts, 25 cycles. Each dynamo has 40 poles, and runs at 75 r.p.m. The engines, built by Dujardin, of Lille, are horizontal four cylinder 1,700 hp. Corliss type, two of the cylinders running at low pressure. A maximum of 1,850 hp. can be obtained. Condensers are fitted in the basement.



Sub-station in Ivry Power Station.

The flywheel is 55 tons in weight, and 24 ft. 7 in. in diameter. The guaranteed consumption of steam is 5.3 kg. per ihp. hour from 1,200 to 1,500 hp., and 5.9 kg. from 800 to 1,200 and from 1,500 to 1,850 hp.

The original installation of boilers included eight Babcock and Wilcox boilers in two groups. This boiler plant has since been increased by the addition of four boilers of larger capacity. In normal working each new boiler is capable of producing 2,200 kg. of steam per hour at 185 lbs. per sq. in.; by forcing, this can be raised to 2,800 kg. Green economizers and Meldrum stokers were provided. The latter have now been replaced by a complete installation of Bennis stokers, which were placed in service at the same time as the new boilers were erected for the extension.

The two sub-stations first provided—one at Quai d'Orsay, and the other at Austerlitz—were distant respectively 3½ miles and 1 mile from the power plant. They each included two sets of machines—one for traction and the other for lighting. The latter consist of synchronous motors taking high pressure current direct from the 1,000 kw. groups in the power station. The output of these motors is 125 kw., speed 500 r.p.m., and they are coupled to 100 kw. dynamos supplying a five-wire lighting circuit, which is in use throughout the installation. The efficiency of these machines is below that of the rotary converter, but the advantage of a constant pressure produced by the dynamo independent of the load on the plant is considered sufficient to justify their use.

For the traction circuit were furnished in each sub-station two groups of three 100 kw. air-blast type transformers, transforming from 5,500 to 340 volts three-phase, two potential regulators, two groups of self-induction coils, and a set of storage batteries of 260 cells, 1,100 ampere hours capacity. Two four-pole rotary converters of 250 kw. output transform the 340 alternating current voltage to 550 volts continuous. These converters run at a speed of 750 r.p.m. The pressure can be varied from 525 to 575 volts. The starting is done by means of the storage batteries, which are usually connected in parallel with the traction circuit.

One of these two sub-stations has now been abolished and new sub-stations created. The rotary converters have always been run with series winding in

opposition to the shunt, and, it is stated, have never given the least trouble. The average voltage on the third rail in the vicinity of the power station has been 550, and the compounding of the rotary converters is so arranged, that at about 350 amperes output the voltage is 575, and at the maximum load the voltage is 525. This may give an idea of the reverse compounding curve of the machine, which, of course, passes through these two points of 350 amperes 575 volts and 650 amperes 525 volts.

Whenever it has been necessary to desulphate the battery, calling for an increase of the voltage to about 700, a potential regulator has been used. Naturally this entails a considerable lagging current, but as the charging is usually done in the small hours of the afternoon, when there is but a small lighting and traction load, it is not a matter of great moment. The de-sulphating is only done about every 10 days or so. Whenever this high voltage is required, the output of the rotary does not exceed 200 amperes, and it has been found possible to obtain this voltage without modifying the series winding of the rotary, or throwing it over so that it acts with the shunt winding. The use of reversible boosters has been avoided by this method of connection.

In addition to the motor generator groups there are a number of balancers consisting of four machines coupled together. Some of these have 5 kw. armatures, and others 10 kw., and they are rated as 4x5 kw. and 4x10 kw.

A few figures relating to the locomotive service may be quoted. The tractive effort developed by one of the locomotives before the 4 to 1 gear ratio was changed, in hauling trains of from 200 to 260 tons at 25 km. per hour, was 2.4 kgs. per ton, and at 50 km. per hour, 4 kgs. per ton. The watt-hours per ton-kilometer, at a speed averaging 28 km, per hour, including five stops, when hauling trains of 200 to 260 tons, were 22. The measurements were made over a run of 7.5 km., and suppose an average voltage of 500 at the locomotive.

The increase in its suburban traffic has led the Orleans Railway Company to investigate the means of improving the service and augmenting the speeds of its trains. The successful results attending the initial electrical installation have brought about an extension of the electric system, and at the present time, the portion of the trunk line from Austerlitz Station through the suburban district as far as Juvisy has been equipped with the third rail, and a frequent and fast service has been created. This service is handled by a number of motor cars equipped with the Sprague Thomson-Houston train control system. The electric locomotives used for the original installation have been modified in their gear ratio in order to give a faster service, and three aditional locomotives have been provided. The locomotives haul main line trains from the Quai d'Orsay terminus to Juvisy, a distance of 14 miles, where the engines are changed and the trains proceed on their way south. The same operation takes place with main line trains on their arriving at Juvisy destined for Paris. The locomotive trains will be operated on a fast schedule, a running time corresponding to over 40 miles per hour being adopted, covering the 12 miles between Juvisy and the old terminus of Austerlitz in about 17 minutes. The suburban trains, equipped with the train control system, make six intermediate stops between these points, and a schedule time of about 22 miles per hour is attained. The time taken to cover the 12 miles, exclusive of stops, is 25 minutes. The stops average about one minute each.

The main change in the original locomotives in order to adapt them to the new service was in the gear ratio. This, orginally 4 to 1, has been changed to 2.23 to 1, giving a faster service. The new locomotives, although very different in appearance to those first put in service, contain practically the same equipment, with the exception that mica-insulated armature coils have been substituted for the cotton-insulated coils used on the eight original machines. An improvement has been made in the rheostat equipment, and reversing switches have been added.

The new locomotives have been built to carry baggage in addition to the electrical equipment, which is contained in end cabins insulated with uralite sheeting. The disposition adopted necessitates the duplication of certain of the apparatus, notably the controllers, two being required instead of the single controller placed in the central cabin of the first locomotives. The additional advantage of baggage carrying capacity was, however, considered a sufficient advantage to offset such drawbacks. The locomotive body is 10.2 m. long, 2.84 m. wide, and 3.87 m. high; the distance between centers of bogie trucks is 5.63 m., and the diameter of wheels 4 ft. 1 in. The weight of the new locomotives, due to the adoption of a steel armored and insulated cab and to the increased dimensions of the locomotive body, is 55 tons.

There are two trains equipped with the train-control system of the well-known Sprague-Thomson-Houston type, each including eight trail cars and two motor-cars, one at each end of the train. The motor-cars are equipped with four motors of the G. E. 66 type, as used in the Manhattan Overhead Railway. The motors are of 125 hp. (at 215 amperes) based on a temperature rise of 75 degs. Centigrade over the surrounding air after one hour's run at full rated load, temperature of surrounding air not exceeding 25 degs. Centrigrade. In this motor special attention has been given to ventilation, large holes with covers being provided at top, bottom and sides of the frame. The latter is not split, but the armature can be taken out endways. Nose suspension is used. There are four field spools, wound with strip copper. The commutator contains 195 segments with mica insulation. The armature has a series drum barrel winding, with armature conductors made of copper bars specially constructed to prevent eddy currents. The conductors are separately insulated in sets of five with mica, which renders them semi-fireproof and able to withstand a high temperature without injury to the insulation. The weight of the motor is 4,300 lbs. The gear ratio is 3.08 : 1, the gear having 71 teeth. One-turn armatures are provided. The guaranteed efficiencies are 86 to 88 per cent. The motor-cars are mounted on bogie trucks of the Baldwin Locomotive Works type. The wheel base is 6 ft. 6 in., 40 in. wheels being used. They each weigh 6,250 lbs., and are calculated to carry a weight of 26,000 lbs., of which 15,000 lbs. is the weight of car (light) on center pin.

The motor-cars are designed with a driver's cabin situated at each end. The remainder of the car is divided into two portions, one with seating capacity for 34 third-class passengers, and the other portion for the conveyance of baggage, etc. The end cabins are lined with uralite sheeting, and the whole of the car-frame is of uninflammable wood. All cabling is covered with asbestos braid, which has been painted lead color. The shoe-leads are passed through flexible armor. The whole construction has been made as secure against fire as possible. All the train control apparatus, of the latest Sprague-Thomson-Houston type, as used on several London tube railways, is mounted in the cabins.

Similarly to the locomotives, the motor-cars are provided with side contact shoes, and also the overhead shoe to take current from the inverted "T" rail. The insulated contacts provided on the motor frames of the original locomotives have been emitted in the motor-cars and also in the new locomotives. The third rail

contact, together with that afforded by the aerial rail, has proved sufficient for all needs.

Westinghouse air-brakes have been fitted to the two trains with motor-cars. The standard of the Orleans Company has been the Wenger air-brake, which is too slow in action for the needs of the new service.

The dimensions of the motor-cars are: Length over buffers, 17.3 m.; height. 3.8 m.; distance, center to center of bogie trucks, 12.4. m.; width, 2.8 m.

In addition to the above increase in rolling stock, the power station has been increased by the addition of one group of 1,000 kw. output, exactly similar to the groups of this size already installed.

(To be continued.)

THEORY OF ELECTROLYTIC DISSOCIATION.

A paper on recent investigations, bearing on this subject, was read before the Faraday Society in London, on November 23, by Prof. L. Kahlenberg, Ph.D. He said that in creating the theory of electrolytic dissociation, the phenomena of actual electrolysis have played a minor part. It has rather been based on the observation that for many aqueous solutions the molecular conductivity increases with the dilution, and that the osmotic pressure, lowering of freezing-point, and similar physical constants are abnormally great. The hypothesis is thus vitally connected with vant's Hoff's theory of dilute solutions which it generalizes in the form of $PV = iRT$, where i, the so-called degree of dissociation, is unity for non-electrolytes, and greater than one for electrolytes. The author is of opinion that the theory is supported by isolated facts only.

Comparisons of the molecular conductivities with the freezing points at 0 degs. and boiling points at 95 degs. were made by the author in 1901, with typical solutions of electrolytes and non-electrolytes, and no such connection between those quantities as demanded by the theory was found.

According to the theory, molecular conductivities should increase with the volume but in practice that is often not the case.

According to the Nernst-Thomson rule, dissociation is caused by the high specific inductive capacity of the solvent, but cases are cited, such as liquid hydrocyanic acid, where a higher dielectric constant than water has is accompanied by lower conducting — and therefore ionizing — power.

Additive properties are not a valid argument in favor of the theory, because they occur in quantities such as molecular heats and molecular refractions, where ionization is out of the question.

The colors of solutions have been attributed to the free ions present, but copper, nickel, and cobalt oleates are insulators, and yet bear the characteristic colors of the supposed metallic ions.

Instantaneous reactions sometimes occur between insulating solutions, and hence cannot be regarded as taking place between the free ions present.

A strong argument against the hypothesis is that it cannot be harmonized with the law of mass-action. The agreements obtained by Ostwald in his application of the dilution law to solutions of weak organic acids are only very rough, and to electrolytes par excellence it cannot be applied at all. Rudolphi's and van't Hoff's amended formulæ are purely empirical.

The power of coagulating colloids has been ascribed to free ions, but such power is not confined to solutions of electrolytes.

It is in the realm of non-aqueous solutions that the theory proves especially impotent. We now know of such solutions that conduct electricity even better than aqueous solutions, and yet yield higher molecular weights than those computed from the formulæ of the solutes. The researches of Walden on liquid sulphur dioxide are quoted as being particularly conclusive.

The theory has been applied to fused salts. The author questions the validity of such application to what are practically 100 per cent. solutions; the hypothesis is avowedly only strictly true for infinitely dilute solutions.

Prof. Kahlenberg does not think the hypothesis can be retained even in a modified form. It must give way to a conception which takes into account the affinity—of the same nature as chemica affinity—between solvent and solute. The processes of solution and chemical action are identical in character, and chemical compounds are merely the cleavage pieces of solutions placed under special stress or duress represented by the so-called purifying processes. Thus chemical action is merely a special case of solution, and the process of solution is the general case of the interaction of bodies resulting from their specific attractions for one another. A dilute solution is merely a limiting case. The abnormal values of molecular weights of substances in solution as determined by change of vapor tension, freezing or melting points, is merely a measure of the affinity between solute and solvent, and has nothing to do with any supposed dissociation; the calculation of molecular conductivities is founded upon the erroneous supposition that the solvent plays no part in the conduction. Recent determinations of osmotic pressures by the author have similarly shown that these depend on the nature of both membrane and liquids, and are by no means in accordance with the requirements of the gas laws. Here, again, as in solutions, affinity is the determining quantity.

Mr. W. C. D. Whetham, in a written communication, pointed out that the problem of the nature of solution was independent of the difference between electrolytes and non-electrolytes, which was all the theory attempted to explain. The ions must be conceived as being free from each other, not from all chemical combination, in order to explain the observed phenomena of conduction.

Prof. Abegg, also in a recent communication, said that Prof. Kahlenberg's reasons for doubting the theory are merely facts which cannot be explained by the Arrhenius theory alone. The latter explains the behavior of dilute aqueous solutious, where the non-ionized molecules are, as a rule, not associated, and not cases where association occurs, such as in non-aqueous solutions. The author further overlooks the fact that conductivity depends on the mobility of the ions, as well as on the degree of ionization. The theory can be harmonized with the law of mass action, as the work of Rothmund and Drucker and Jahn has shown.

Dr. T. M. Lowry said that Prof. Kahlenberg's criticisms were mostly expended on a theory which was not the dissociation hypothesis as conceived to-day. The theory does hold good for concentrated solutions, only we are not yet able to measure the degree of ionization in such cases. His laws are not quite true for moderately dilute solutions, because some of the molecules of the solutes are in combination, and not free. He dealt at length with the various points raised by the author.

Dr. G. Rudorf referred to the question of the color of solutions, and showed that on the assumption that the molecule of copper sulphate has nearly the same light-absorbing properties as the ion, all difficulties disappear. The theory quite explains the reactions mentioned in benzine solution, if only very few ions are assumed to be present.

Dr. H. Borns showed that Prof. Kahlenberg's capital mistake was that he attacked everything that had ever been said or done with the theory. He ignored recent modifications of it that the ideas of

hydrolysis, complex ions, and association have caused.

Dr. H. Sand (communicated), dealt with the differences between the theory of Clausius, and that of Arrhenius, and discussed some of the approximate assumptions that lead to numerical disagreements in the applications of the latter.

Dr. C. H. Desch discussed Prof. Kahlenberg's experiments with copper oleate in benzine solution, and described some experiments of his own bearing on the subject. He thought the difficulties raised by non-aqueous solutions very serious ones.

Mr. F. S. Spiers drew attention to the theory of Traube, which gave numerical expression to some of the conceptions of solution apparently held by Prof. Kahlenberg, and explained the Arrhenius coefficient i in terms of the affinity between solute and solvent.

American Institute of Electrical Engineers.

The next regular meeting of the Institute will be held at the Chapter Room, Carnegie Hall, 154 West 57th street, New York, on Friday, December 23, at 8.15 P.M. The subject of the meeting will be "Transmission Problems." The following paper will be presented and discussed: "The Maximum Distance to which Power can be Economically Transmitted," by Ralph D. Mershon. Mr. Henry G. Stott will open the discussion of this paper.

Boston to New York by Trolley.

It is now possible to travel the entire distance between Boston and New York by trolley, the time taken from Park Square, Boston, to the Grand Central station, New York, 254 miles, being 20 hours, and the cost $2.85.

Fifteen changes of cars are necessary, the longest stretch being between Boston and Worcester, 40 miles, the fare being 35 cents and the schedule running time, 2 hours and 15 minutes. The stretch between Palmer and Worcester is two miles less than the Boston & Worcester route yet the running time is 3 hours and the fare 55 cents.

The cheapest part of the trip is between Mount Vernon and Larchmont, a distance of 15 miles, the fare being but 5 cents, although two changes of cars are necessary, transfers being issued in both instances.

Dr. Svante Arrhenius, professor of physics at the University of Stockholm, Sweden, has been called to the University of Berlin.

N. E. L. A. Convention Dates.

At a meeting of the executive committee of the National Electric Light Association, held in New York, December 6, the dates fixed for the Denver-Colorado Springs Convention were June 6, 7 and 8 at Denver, and 9, 10 and 11 at Colorado Springs. Mr. Henry L. Doherty has already organized a local executive committee in Denver to take up arrangements for the convention, with a number of special committees that are already at work. This looks as if the Far-Western meeting would not be allowed to suffer by comparison with any previous meeting, if prompt and energetic work can secure its success.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until December 27, for furnishing the New York Navy Yard with a quantity of desk and bracket fans, panel boards, cable, generating sets, coils for thermostat springs, and miscellaneous electrical supplies. Blank forms of proposals and specifications can be obtained upon application to the Navy Pay Office in New York City. The Bureau will also receive bids until January 17, 1905, for furnishing the Mare Island and Puget Sound Navy Yards with a quantity of motors, electric wire, cable and conduit, circuit brackets, ammeters, generating sets, and miscellaneous electrical material. The Bureau will furnish blank forms upon application.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DEC 13, 1904.

Electric Railways and Appliances.

777,091-092. System of Electrical Distribution for Electric Railways. Josef H. Hallberg, Cincinnati, O. Filed March 14 and 26, 1904

777,124. Magnet Contact for Propulsion of Cars. James M. Morgan, Toledo, O. Filed July 28, 1904.

777,152. Car-Fender. Earl Sherwood, Honesdale, Pa. Filed April 1, 1904.

777,304. Trolley-Pole. Andrew L. Prentiss, Buffalo, N. Y. Filed Feb. 23, 1904.

777,468. Holder for Trolley-Wires. Frank M. Zimmerman, Aurora, Ill. Filed Sept. 16, 1904.

777,482. Trolley-Car Sign. Peter McDonald, Harrison, N. J. Filed March 29, 1904.

777,616. Electric-Trolley. Theophile Euphrat, Norwalk, Conn., assignor of three-fourths to the Hurwood Manufacturing Company and George J. Tischer, New Haven, Conn. Filed April 13, 1904.

Electric Lights and Appliances

777,146. Electric-Arc Lamp. Lafayette E. Safford, Allegheny, Pa., assignor to the Keystone Electric & Manufacturing Company, Pittsburg, Pa. Filed Aug. 19, 1903. Renewed May 18, 1904.

777,490. Electric-Arc Lamp. Hugo Bremer, Neheim, Germany, assignor, by mesne assignments, to the Westinghouse Electric & Manfacturing Company. Filed March 26, 1902.

777,631. Switch for Arc-Lamp Circuits. Robert H. Henderson, Newark, N.J., assignor to the Westinghouse Electric & Manufacturing Company. Filed March 20, 1903.

Electrical Machinery and Apparatus

777,118. Emergency-Brake. George Macloskie, Schenectady, N. Y., assignor to the General Electric Company. Filed March 21, 1903.

777,164. Electric Make-and-Brake Mechanism. James C. Waldo, Sharpsburg, Pa., assignor or one-fourth to John J. Forster, Avalon, Pa. Filed Oct. 19, 1903.

777,194. Variable-Speed Dynamo. Arthur J. Farnsworth, New York City, assignor to the Railway Electrical Equipment Company, same place. Filed Aug. 1, 1902.

777,198. Alternating-Current Motor. Valere A. Fynn, Bradford, Eng. Filed Sept. 17, 1903.

777,229. Power-Transmitting Mechanism. Charles C. Vaughn, San Francisco, Cal., assignor of one-half to George J. McConnell, same place. Filed March 31, 1904.

777,343. Variable Speed Power-Transmission Device. William F. Howe, Chicago, Ill. Filed Nov. 16, 1903.

777,460. Regulatable Power-Transmission Device. Frank V. Whyland and Clarence P. Hollister, Pittsfield, Mass. Filed March 4, 1904.

777,536. Electric Controller. Weston A. Price, Cleveland, O., assignor to the Electric & Dental Specialty Company, same place. Filed Feb. 24, 1903.

Telephones and Telephone Apparatus

777,172. Telephone Attachment. Herbert G. Addie, Cresco, Ia. Filed May 20, 1904.

777,216. Apparatus for Wireless Telephony. Sigmund Musits, Steinamanger, Austria-Hungary. Filed Nov. 24, 1902.

777,217. Telephone Service-Meter. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed April 16, 1900.

777,301. Busy Signal for Telephone-Exchanges. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed April 1, 1901.

777,310. Telephone Disinfecting Device. William H. Rose, Catonville, Md. Filed Sept. 3, 1904.

777,324. Telephone System. Charles Adams-Randall, Boston, Mass. Filed Dec. 22, 1903.

777,429. Party-Line Telephone System. Walter Parker, Leicester, N. Y. Filed Jan. 13, 1904.

777,525. Telephone Toll Apparatus. George A. Long, Hartford, Conn., assignor to the Gray Telephone Pay Station Company. Filed Jan. 5, 1903.

777,544. Telephone System. John G. Roberts, Detroit, Mich., assignor to the Kellogg Switchboard & Supply Company. Original application filed Dec 15, 1899. Divided and this application filed Feb. 24, 1902.

777,583. Sanitary Attachment for Telephone-Transmitters. Henry Baethig, Buffalo, N. Y. Filed April 25, 1903.

Miscellaneous.

777,061. Cigar-Lighter. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Filed June 15, 1903.

777,067. Automatic Fire-Alarm Transmission. George B. Bowell, West Kensington Park, Eng., assignor to the Pearson Fire Alarm System, Limited, London, Eng. Filed July 7, 1902.

777,106. Casing for Electric Push-Buttons. Henry F. Keil, Bronxville, N. Y. Filed May 17, 1904.

777,116. Automatic-Rheostat. Robert J. Louis, New York City. Filed March 4, 1903.

777,148. Magnet-Coil. Albert Schweitzer, Pittsburg, Pa., assignor to the Keystone Electric & Manufacturing Company. Filed Aug. 9, 1901. Renewed May 18, 1904.

777,153. Contact Device for Electric Self-Playing Musical Instruments. Irving B. Smith, Philadelphia, Pa., assignor to the Stokes & Smith Company, same place. Filed July 14, 1904.

777,246. Rheostat. Henry H. Cutler, Milwaukee, Wis. Filed Nov. 21, 1902.

777,290. Variable Inductive Resistance. Thomas B. Kinraide, Boston, Mass. Filed May 25, 1904.

777,312. Multiplex Telegraph System. Harry Shoemaker, Philadelphia, Pa., assignor of one-half to Marie V. Gehring, same place. Filed Jan. 18, 1904.

777,439. Rheostat. William L. Schmidt, Easton, Pa., assignor of one-half to William S. Brotzman, same place. Filed June 7, 1904.

777,457. Battery-Case. Reinhold H. Wappler and Frederick H. Wappler, New York City. Filed April 20, 1904.

777,496. Induction Apparatus. George M. Christoph, Chicago Ill., assignor to the Western X-Ray and Coil Company. Filed May 15, 1903 Renewed Oct. 21 1904.

777,503. X-Ray Tube. Robert Friedlander, Chicago, Ill. Filed Sept. 12, 1904.

777,506. Thermo-Electric Alarm. Anton Haslinger, Allegheny, Pa. Filed April 30, 1904.

777,555. Electric Signaling System. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Filed July 28, 1903.

THE TELEPHONE WORLD.

Keystone Company to Reach Middle West.

Long-distance connection with points as far west as Kansas City and St. Louis via the lines of the Keystone Telephone Company, was one of the most important matters settled last week at a meeting in Philadelphia, Pa., of the Eastern Traffic Association of Independent companies.

The meeting followed a session of the Pennsylvania State Independent Telephone Association in the offices of the Keystone Company. Officers of companies in Pennsylvania, New Jersey, Delaware and Maryland were present. New rates, rules and regulations were fixed by the Traffic Association and announcement was made that the new long distance service will be in operation early in the year.

Among those who attended the meeting were:

W. T. Burroughs, traffic manager Maryland Telephone & Telegraph Company; G. B. Rudy, York Telephone Company; H. E. Bradley, superintendent, Eastern Traffic Association, Philadelphia; C. E. Wilson, general manager, Keystone Telephone Company, Philadelphia; William W. Olheiser, manager Eastern Telephone & Telegraph Company, Camden; Senator C. W. Kline, Consolidated Telephone Companies of Pennsylvania, Hazleton; F. D. Houck, superintendent United Telephone & Telegraph Company, Harrisburg; T. York Smith, treasurer Camden & Atlantic Telephone Company, and many others.

Combine Raises Rates.

Business men and other patrons of the Michigan Telephone Company and the Twin City Telephone Company in Benton Harbor and St. Joseph, Mich., are in revolt because of the notice given that after the 1st of January a rental of $30 per year will be charged for 'phones in business houses. The old rate is $18 per annum. Dissatisfaction is so pronounced that there is some talk of the organization of an Independent company. Several months ago the Michigan Company and the Twin City Company effected an agreement whereby the former was given absolute right to do business in St. Joseph, and the latter in Benton Barbor.

The Canton, Ill., Home Telephone Company will commence the construction of a line to Fiatt as soon as the material can be placed upon the ground. Connection will be made at Fiatt with lines running to all parts of the county, and also to the principal cities in the adjoining counties, such as Galesburg, Peoria, Havana and other places. This service will be of great advantage to the patrons of the Canton Home Company.

The Whitewater Telephone Company is completing its line from Whitewater to Wichita, Kan. The line will connect with the lines of the Wichita Independent Telephone Company at Wichita. The Whitewater line is a rural one. It has over 200 subscribers. The company is a mutual affair. All subscribers are stockholders.

The Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent., payable December 30. Books close December 26, reopen December 31. There will be no new stock issue this year.

Union Independent Company Elects Officers.

The annual meeting of the stockholders of the Independent Union Telephone Company was lately held in Albany, N. Y. The following directors were elected: Samuel B. Rawson, Theodore M. Brush, Irving H. Griswold, Frederick H. Sudro, Frederick M. Mastin and Addison E. Lord. At a subsequent meeting of the board of directors, the following officers were chosen: Samuel B. Rawson, president; Irving H. Griswold, vice-president; Theodore M. Brush, secretary and treasurer. The Independent Union Telephone Company is the toll line, or long-distance company, which connects with the Independent Telephone exchange in the States of New York and Vermont and afford long-distance service and connections with the Home Telephone Company.

To Build Rural Telephones.

The Rural Telephone & Telegraph Company, which was recently incorporated at Belleville, Ill., plans to erect telephone lines throughout St. Clair County.

Belleville men are at the head of the movement, and they state that the line will be in operation over the entire county inside of a few months. The capital stock of the company is $2,500, and the incorporators are Albert Hucke, L. D. Turner and George Detharding. County Superintendent of School Charles Hertel and Adolph Knobeloch are also interested in the company.

West Palm Beach, Fla., is considering an important question of a franchise for a new telephone company, or rather the encouragement of the old company, provided it be reorganized and guaranteed to furnish good service. It was decided by the council to appoint a special committee to investigate the telephone matter and report at the next meeting, in order that intelligent action might be taken. Aldermen Grier, Parrish and Sirkin were chosen as a committee.

The Michigan State Telephone Company lately completed a new line from Battle Creek to Climax via the Goguac prairie road. This company is also building a rural line from Battle Creek to Dowling, in Barry County. It leaves the former city at Verona via the old Fonda road, going to Assyria and Lacey, and thence to Dowling. This line will extend 20 miles, and will be the longest rural line running out of Battle Creek. Although extending into Barry County, it will be connected with the exchange from Battle Creek. The section of the country through which the line passes has been isolated for years, and will be a great convenience to the people in that section of Barry County, as well as to the merchants of Battle Creek.

The People's Telephone Company, of Bartlett, O., has increased its capital stock from $5,000 to $15,000.

The Interstate Telephone Company has begun the construction of a trunk line from Vineland to Pleasantville, N. J.

The Columbia Telephone Company, is extending its lines from Elizaville to Pine Plains, N. Y.

Three Georgia Companies Combine.

At a meeting of the Monroe Telephone Exchange Company, the Walton Telephone & Telegraph Company, and the Monroe and Compton Telephone & Telegraph Company in Monroe, a short time ago, a consolidation of all the companies resulted, and, beginning January 1. will be styled the Monroe Telephone Company.

The consolidation is with a view to combining the entire strength and giving the public a better service.

Telephone Contest.

It is announced that the residents of Wolcott, N. Y., will be told about January 1, what the rate will be for Bell telephones. One year ago the Independent telephone movement and the Bell Company began to hustle for the business of Wayne County. The Bell people have since that time installed free telephone exchanges in both Wolcott and Sodus. The Independent company has paid little attention to Wolcott, but has surrounded that village with Independent 'phones.

The Palmyra, Neb. Telephone Company has filed articles of incorporation. The intention of the new company is to connect with the Independent telephone lines of Lincoln and Nebraska City. The capital stock is $4,000, fully subscribed. The incorporators are L. E. Jones, A. R. Maiben, W. H. Epley, T. L. Stewart and O. M. Merwin, all of Palmyra.

The Selective Telephone Company, with registered office at 76 Montgomery street, Jersey City, N. J., and capitalized at $200,000, has been incorporated by Le Roy S. Lewis, James R. Carroll, W. S. Davis and John J. Mara. The company is to manufacture and deal in selective telephone appliances under United States patents.

It is definitely announced that H H. Smith, Paul Laborde and several other prominent citizens of Covington, La., will organize a telephone company, and put in an up-to-date local exchange. They claim that this is necessary on account of the lack of accommodation afforded at present, and that they will have no difficulty in getting all the stock taken in Covington.

Ventnor, N. J., wants telephone service, but draws the line on overhead wires. In passing on the first reading a franchise for the Atlantic Coast Company the city council made it conditional that the company place all its wires underground within five years after the enactment of the grant.

Telephone Incorporations.

The Blue River Telephone Company, of Washington County, Salem, Ind. Capital stock, $1,200.

The Middle Branch Telephone Company, Norwalk, Ia. Capital stock, $1,200. Incorporators; W. A. Cotinam and others.

The Farmers' Mutual Telephone Exchange Company, Alexis, Ill. Capital stock, $5,000, Incorporators: Allen Moore, Warren Bruington and R. T Shaw.

The Lamonte Telephone Company, Lamonte, Mo. Capital stock, $5,000. Incorporators: W. E. Files, W. F. Yankee, H. C. Mitchell, Arthur Bender, Joseph F. Staples, James A. Staples and others.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alma, Wis.—The Alma Electric Light Company has been incorporated with a capital stock of $5,000 by John Harry, Russell N. Smith, Frank Harry and Charles Schaettle.

Batavia, N. Y.—The village board of trustees has authorized a contract to replace all of the electric lights in this village with inclosed arc lamps at a cost of $2,375.

Chambersburg, Pa.—Charles Walters has purchased the electric light plant on behalf of a corporation to be known as the Chambersburg Light, Heat & Power Company,

Clarksville, Ark.—Col. E. T. McConnel is making arrangements to build an electric light plant for this place.

Dallas, Ore.—The power plant of the Dallas Electric Light Company will soon be extensively improved; new machinery is to be added.

Eldorado, Kan.—A franchise to erect an electric light plant has been granted by the city council to W. Martin Jones.

Fairfield, Ia.—The city council has made a contract for a new electric lighting plant.

Fulton, Ky.—It is rumored in business circles that a new electric light plant will be erected at an early date, and that local capitalists will furnish the means.

Hale, Mo.—An electric light plant is to be erected here. The company will be known as the Citizens' Electric Light & Water Company. The officers are A. J. Herron, president; W. L. Ballew, secretary and treasurer; Fred Hahner, general manager.

Harrisville, N. Y.—The Harrisville Electric Light & Power Company, of Harrisville, Lewis County, has been incorporated with a capital of $10,000, by Thomas J. Wilbur, Joseph Weeks, Sr., and others, of this place.

Hattiesburg, Miss.—It is reported that G. L. Hawkins and associates have secured a franchise to erect an electric light plant.

Houston, Tex.—A charter was lately granted to the Humble Electric Company with a capital stock of $30,000. It is the intention of this company to erect an electric light plant in that new town.

Indianapolis, Ind.—The board of public works has authorized the placing of 31 electric lamps at various street corners of this city for improving the lighting service.

Ladysmith, Wis.—The Ingram Lumber Company has purchased all the interests of the H. A. Ostrander Company here, and will make many improvements, among which is an electric light plant.

Loomis, Wash.—It is stated that John Lloyd has ordered machinery and will erect a plant to install a 750 hp. electric light plant for the Palmer Mountain Tunnel Company.

Matthews, Ind.—The Matthews Electric Light Company, capitalized at $15,000, has the following directors: Philip Hughes, G. S. Rineboldt and Everett W. Trook.

Miamisburg, O.—The issue of $19,000 in bonds has been authorized by this village for the purpose of enlarging and improving the electric light plant. The bonds will be 5 per cent. for 20 years.

Midway, Minn.—The Electric Light & Power Company will erect a new plant here.

Monroe, Wis.—An effort is being made to reorganize the Monroe Electric Light & Power Company into a larger concern, increasing the capacity of the plant.

North Tonawanda, N. Y.—The Home Electric Light & Power Company has petitioned the board of aldermen for a franchise to erect, string and maintain the necessary cables, wires, etc., for the distribution of electricity for lighting and power purposes.

Obion, Tenn.—The Obion Lighting Company of this place has been incorporated with a capital of $6,000, to erect an electric light plant. J. E. Trout, L. A. Watt and I. Rosenthal are the incorporators.

Orange, Cal.—The city trustees have decided to call an election January 7 to vote on the issuance of bonds in the amount of $75,000; $15,000 of this to be used for an electric lighting and power plant.

Ozark, Mo.—This city will soon vote on a proposition to issue bonds for a city hall, waterworks, electric light plant, sewers, fire department, etc.

Renovo, Pa.—It has been decided to ask for bids to light the streets with arc and incandescent lights, at the same time to ask for bids for the construction of a municipal electric light plant.

St. Louis, Mo.—The Union Electric Light & Power Company has suffered a fire loss of $5,500.

STREET RAILWAYS.

Albany, N. Y.—The Buffalo & Rochester Railway Company of Depew has been incorporated with a capital of $3,000,000, to construct an electric road 60 miles long from Depew to Rochester. The directors are Henry H. Kingston, J. Andrews Harris, Jr., John J. Collier, Horatio A. Foster, T. Henry Dixon and Samuel Welsh, of Philadelphia, and William B. Cotter, George A. Ricker and Herbert P. Bissell, of Buffalo,

Grandview, Ind.—The citizens of this place are very much in favor of the traction road to be built between here and Cannelton.

Hannibal, Mo.—The promoters of the Missouri & Illinois Electric Company propose to build an electric road between here and Quincy.

Knoxville, Tenn.—Ford, Bacon & Davis, of New York, have bought out the Knoxville Street Railway & Electric Light Company here. Extensive improvements will soon be made.

New Haven, Conn.—Next month the Consolidated Railway Company, the electric traction holding corporation of the New Haven Railroad, will apply to the General Assembly for permission to complete the gridiron of trolley lines in this State. Permission is asked to extend the Baltic line from Norwich to Jewett City, to extend the line from Portland to Glastonbury, and from Middletown to Westfield, and from Meriden to Berlin.

Paoli, Ind.—A survey is to be made for an electric road from Bedford to French Lick Springs The proposed road will be by way of Mitchell, Orleans, Paoli and West Baden Springs, and will cover a distance of 30 miles, running parallel with the Monon.

Shelbyville, Tenn.—Dr. F. B. Reager, of this place, in connection with a Detroit firm of capitalists, proposes to build an electric railway connecting this place and Huntsville, Ala. Work on the road, however, is not expected to begin until spring.

Winona, Ind.—The people of this city, are making rapid progress in planning the electric road from Warsaw to Goshen.

POWER PLANTS.

Beckley, W. Va.—John W. McCreary, Thomas H. Wickham Thomas H. Lanig and associates have incorporated the Beckley Electric Light & Power Company, with $25,000 capital, to construct and operate electrical power plants, etc.

Fort William, Ont.—It is stated that Herbert S. Holt, president of the Montreal Light, Heat & Power Company of Montreal, is interested in a company, which has purchased extensive electric power near here. It is stated that arrangements have been made for constructing at once a plant to produce 30,000 hp. at the commencement, and 50,000 hp. later.

Hamilton, O.—The Hamilton Otto Coke Company has decided to spend about $200,000 in the improvement of its Hamilton property and will establish an electric power plant.

Marion, S. C.—The Secretary of State has commissioned the Carolina Water, Light & Power Company of this city, which proposes to have a capital of $250,000. The company will build a power station. The petitioners are J. W. Johnson and W. J. Montgomery.

Newberry, S. C.—M. G. Houseal, C. H. Cannon and W. K. Slight, of this city, and others, have incorporated the Parr's Shoals Power Company with $50,000 capital, with the privilege of increasing it to $1,000,000. The company purposes developing the water power at Parr's Shoals, and erecting an electric light plant to transmit the power.

BIDS WANTED.

Birmingham, Mo.—The Witthoff Brick Company of this place wants prices on machinery and equipment for an electric light plant.

Chattanooga, Tenn.—The Terrel-Hedges Company, 108 East 8th street, this city, is in the market for electrical supplies.

Dallas, Ga.—B. A. Wright, chairman of the committee of the Dallas Light, Power & Water Company, wants prices on equipment for an electric light plant, including boiler, engine and dynamo.

Greenville, Ala.—C. C. Henderson, of this city, wants to correspond with manufacturers of electrical machinery and equipment.

Hanover, Pa.—Bids for furnishipg light for alleys, streets, etc., either gas or electric arc lights for a term of 1, 3, 5 or 10 years, will be received until December 31, by Charles B. Wirt, borough secretary.

Lexington, N. C.—Samuel B. George and J. E. Kaufman, of this place, are in the market for a small electric light plant to be run by a gasoline or oil engine.

Roswell, Ga.—The Roswell Manufacturing Company wants a 200 hp. engine, second hand, and in good condition.

Washington, D. C.—James Knox Taylor, supervising architect of the Treasury Department, will open bids December 27, for the installation of an electric conduit and wiring system for the United States Post Office at Leadville, Col.

NOTES FOR INVESTCRS.

Latest quotations for copper are: Electrolytic, 14¾@15c.; Lake 14⅞@15⅛c.; casting, 14½@14¾c.

The annual meeting of the Boston Elevated Railway Company will be held January 2.

In the reorganization of the New Orleans Railways Company plans are made for a reduction of capital and an assessment of shareholders.

The stockholders of the Toledo Railways & Light Company will hold their annual meeting at the office of the company in Toledo on January 10.

The North Jersey Electric, Heat, Light & Power Company, capital $500,000, has been incorporated and will compete with the Public Service Corporation.

The West End Street Railway Company (Boston Elevated Railway Company, lessee) will on January 2 pay a dividend of $2 a share on the preferred stock.

The annual meeting of the stockholders of the Minneapolis General Electric Company will be held at the principal office of the company in Jersey City, N. J., January 12.

The chances of the directors of the Western Telephone Company increasing the dividend on the preferred stock next month to a 6 per cent. basis are considered very slight.

The $2,000,000 five per cent. bonds of the Winnipeg Electric Railway Company, offered by the Bank of Montreal and N. W. Harris & Co., have been very largely over-subscribed.

A report comes from Chicago that at its meeting next month the Metropolitan Elevated Company will resume the dividends on the preferred stock which were discontinued two years ago.

Mayor McClellan and Comptroller Grout of New York have determined that the city shall have a municipal electric lighting plant. They claim the city can save $900,000 a year by making its own light.

In connection with the meeting of the directors of the American Telephone & Telegraph Company this week to declare the regular quarterly dividend of 1½ per cent. and ¾ per cent. extra, rumors are current that ex-Governor W. Murray Crane would sever his official relations with the company.

The quarterly report of the Western Union Telegraph Company for the quarter ending December 31, 1904, shows a surplus of $15,434,862.80. The company has declared the regular quarterly dividend of 1¼ per cent., payable January 16 next. Books closed December 20 and reopen on January 3.

There was a scramble for traction shares on the Chicago Stock Exchange on Monday and resulted in an advance of 9 points in West Chicago Street Railway. Early bids for the stock ranged from 51—the closing price on Saturday—to 59, at which quotation 700 shares changed hands. A committee has been appointed, consisting of the following men, to solicit proxies for the annual meeting of the stockholders of the North Chicago Street Railroad Company and of the West Chicago Street Railroad Company to be held in Chicago January 10: Alfred Skitt, formerly vice-president and general manager of the Manhattan Railway Company; Charles A. Coffin, president of the General Electric Company; J. N. Wallace, vice-president of the Central Trust Company; Geo. R. Sheldon, of the firm of William C. Sheldon & Co., and R. R. Govin, of the firm of H. B. Hollins & Co. This committee represents the Eastern interests in the Chicago Union Traction Company.

ELECTRICAL STOCK QUOTATIONS.

Name.	Closing price Dec. 19.
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
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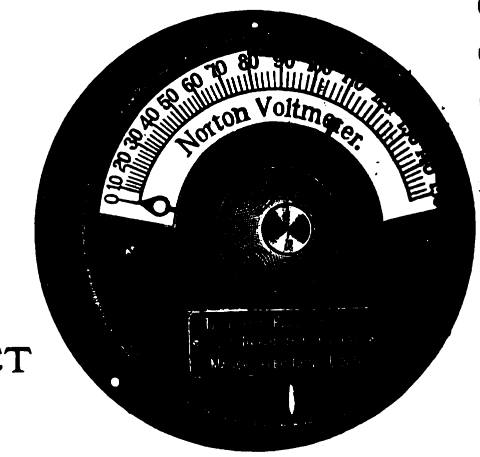

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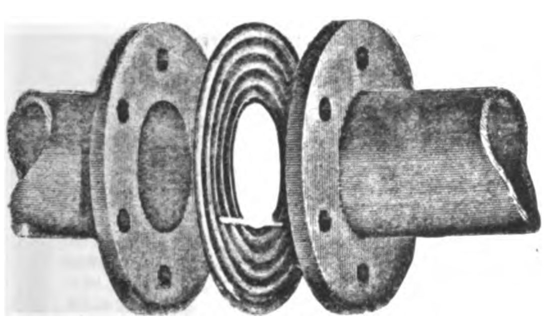

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CONTENTS.

EDITORIAL NOTES.

The Year 1904 and the New Year.

Christmas having come and gone and the year 1904 being about to expire it is only meet that we should say a few words about the past twelve months and the outlook for the year that is to come.

With the exception of one or two months the year 1904 has been fairly prosperous for the electrical industry. Large contracts for electrical machinery and apparatus were placed and several important undertakings, involving a large expenditure of money, for electrical equipment were brought to a close. When it is taken into consideration that business was fairly good in spite of its being a Presidential election year, there is little cause for complaint.

With the political excitement over business picked up and will continue to pick up unless some unforeseen calamity should overtake the country.

The little game which certain financiers have lately seen fit to indulge in in Wall Street "for the good of the public," and which has affected the copper and other securities, has not had a tendency to cause business men to feel more secure, in fact has made many experience a sense of nervousness. In a country such as this, where almost every business man is necessarily more or less interested in certain securities, manipulation of the financial market by powerful interests must inevitably create a sense of uneasiness. It is therefore to be hoped that this fight against the "system" or "cleaning-up" process or whatever it may be, will shortly come to an end.

With no menacing cloud in the business horizon, there would seem to be no reason why the year 1905 should not be an excellent one from a financial standpoint for electrical manufacturers, dealers and contractors. In this vicinity alone there are large electrical undertakings hanging in abeyance which will shortly require an immense amount of machinery and apparatus and the services of many electrical experts. We trust all our advertisers and readers will get their share and take this opportunity of wishing them all a "Happy New Year."

* * *

Iron from its Ore by Electricity.

The academic school always objects to innovations, and this is peculiarly so in the schools of metallurgy. Here, the time-honored methods of ore reduction prevail and anything approaching a radical change in character is classified as belonging to the theoretical and therefore impracticable methods of visionary experimenters. Since the days of Tubal Cain, the mining, ore reducing and metal working processes have advanced, not so much in the line of radicalism as in magnitude. In Japan, China, India and the Mohammedan centers of an almost archaic civilization there still prevails the old conservatism which in connection with ore reduction involves a tremendous waste of energy and material.

The Western world, by embracing the principles of advanced science, has been able to resurrect from this unprogressive system of ore reduction new lines of thought, which when crystallized represent the processes in vogue wherever vast quantities of iron ore are to be reduced for practical purposes. But these methods are all of one general character and do not differ essentially from those employed in the days of Egyptian Pharoahs or Chaldean Kings. The ore in every case is reduced by fire, and all the opportunities so well known to pro-

fessional metallurgists therefore exist, through which impurities mix with the molten mass, and thus call for repetitions of the process to secure pure metal. Coal, with its carbon, sulphur and gases, is bound to impart impurities, which in many instances not only destroys the integrity of the outflowing metal but creates a commercial condition which contracts the profits of the plant to a marked degree. Here, then, is a situation calling for a change, through which such remedies can be applied as will tend to produce an output of higher intrinsic value.

With electricity costing from $25 to $50 per horse power per annum it is claimed that the reduction of ore in the electric furnace is not a practical commercial success. The truth of this statement cannot be disputed but possibilities which will lead to an entirely different conclusion may be advanced along equally if not more logical lines.

Electricity at the coal fields is cheap. A ton of culm will not cost more than 50 or 75 cents. From it, at least 400 hp. hours can be obtained. In a working year of 300 days, estimated at 10 hours a day, 3,000 hp. hours would cost not more than from $4 to $6.

Then consider the ease and rapidity with which the molten iron is obtained. This is as important an item as the question of cost. A high grade electric plant which would include the finest make of engines could turn out electric power at the coal fields at a ridiculously low figure. The ore is only a stone's throw away. Why then is discussion necessary? If there be any, it is surely to prove the commercial and scientific superiority of the method of electrical reduction of iron ore over the antiquated and apparently unprogressive methods of the past. If Tubal Cain is to be improved upon, it will never be by the wasteful methods of the blast furnace. Cheap electricity will surely solve the problem.

* * *

The Destruction of the Glen Island.

The recent destruction of the steamboat Glen Island by fire, while in the Sound, resulting in the loss of nine lives, brings up the question as to why the electric lighting apparatus and wiring of this boat was not more thoroughly inspected.

If a man builds a country house and has a contractor wire it for twenty-five electric lights, before he can get it insured it must be inspected twice by an expert representing the Board of Fire Underwriters.

The wiring is inspected when it is completed and it is again inspected when the fixtures are in and the current ready to turn on. If such care is taken to guard against fire in a small house containing only a few persons, there is all the more reason for careful inspection to guard against fire on a structure that plies on the water and at times contains many hundreds of people, who in case of fire cannot readily escape.

A daily paper, referring to the matter, states that the Glen Island was not insured in any marine insurance companies, but she was insured in seven different fire insurance concerns for $23,750. The fire insurance companies were supposed to inspect the Glen Island regularly to protect themselves against fire loss.

The same paper comments as follows: "It was up to the New York Board of Fire Underwriters to do this for the sake and protection of the interests of the seven land companies in which she was insured.

"So far as the records of the New York Board of Fire Underwriters and the certificates in possession of the Starin Line indicate, the last overlooking by the underwriters occurred on February 10, 1894.

"If the board was content not to make regular examinations of the Glen Island it was up to the fire insurance companies to foot the loss, as it was not the duty of the steamboat line to ask for an examination from the board."

This footing of the money loss is all right, but how about the nine lives that were lost? Had it been summer hundreds might have been lost instead of nine. A vessel, and especially an excursion steamboat equipped with an electric lighting plant, should be inspected by an expert from the Local Bureau of Steam Vessel Inspectors. At present there is no provision made for Federal inspection of lighting plants on vessels, but Congress should pass a law with this object in view, and the sooner such a law becomes operative the better it will be for the traveling public.

The Board of Commissioners appointed by the last Legislature to investigate the various proposed systems of electrical towing for the canals and report to the Legislature held a meeting in this city recently. The sub-committee on plan presented a report to the effect that the board should consider only plans for systems of towing, traction or propulsion which shall be suitable to the "$101,000,000 canal." The discussion over this report developed that the opposition to the barge canal is active yet. The report was adopted by a vote of 9 to 4. The subcommittee will meet at the Murray Hill Hotel at 11 A. M., January 5 next, to receive plans "for electric towing on the enlarged canal."

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Sir Oliver Lodge, last week in London, successfully tested his apparatus for dispersing fog by electricity.

The annual meeting of the Electrical Contractors' Association of New York State will be held on Tuesday, January 17, at Troy.

A cable dispatch from Rome, December 26, says that experiments with the Artons system of radio-telegraphy have been made between Rome and Sardinia, resulting in a successful demonstration of the inventor's claims that an electro-magnetic wave message transmitted by this system cannot be diverted from the point for which it is intended. King Victor Emmanuel, who witnessed the test, congratulated the inventor upon his achievement.

President Fish of the American Telephone and Telegraph Company says that developments in connection with the Pupin coil are proving highly satisfactory and will make commercially possible long distance business between such points as Boston and Kansas City. It will permit conversation under any weather conditions which, without it, would be impossible. It accelerates sound and overcomes other noises on the wires at the same time.

The advantages of electricity for driving cotton mills have obtained recognition in Spain, where one of the largest proprietors has decided to introduce it. His two spinning and weaving mills at Malaga, says the "Electrical Engineer," London, are the biggest in the country, employing some 5,000 hands. Arrangements have lately been made by him for obtaining a supply of electric power from the Chorro Power Company, which has established a generating station in the celebrated Chorro Gorge, some 50 miles north of Malaga. The power is transmitted by three-phase current at a pressure of 25,000 volts to a sub-station in Malaga, where the pressure is reduced to 2,500 volts, part of the energy being supplied to the Malaga electric lighting station.

ELECTRICAL WINDING PLANT AT THE LIGNY-LES-AIRE MINES.*

It was necessary that this plant should be capable of hoisting 105 tons of coal per hour from a depth of 1,312 feet at a speed of 26.2 feet per second. Each cage provides accommodation for four trucks having an aggregate capacity of 4,900 lbs. Since one hoist occupies 60 seconds and the loading and unloading of the cage another 15 seconds, it follows that 48 hoists may be made per hour. The tower, shown in Fig. 1, was built directly

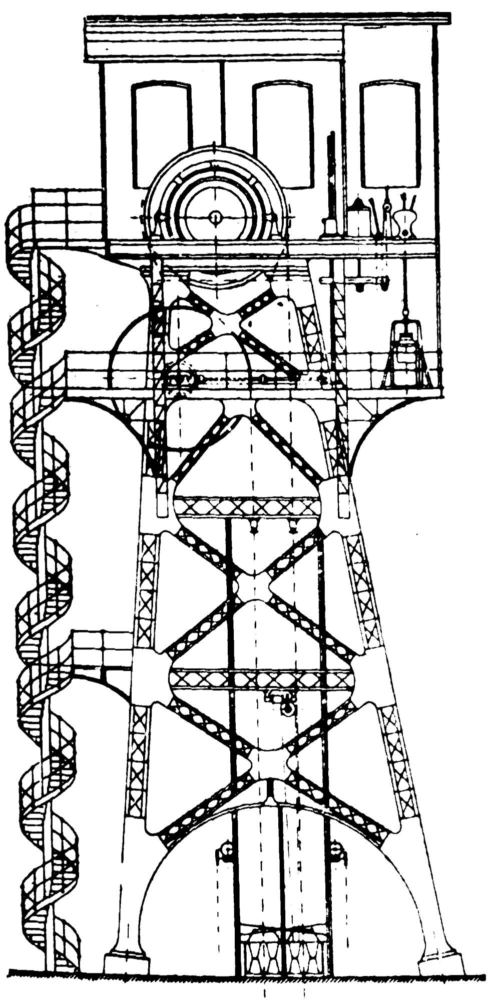


FIG. 1.

over the pit mouth, the winding gear being erected at a height of 69 feet above the ground. As seen in Fig. 1, the winding gear forms, to a large extent, part of the tower itself, the weight of which is 120 tons. The base of the tower is formed by four cast-iron limbs, which rest on brickwork foundations situated at the corners of a square, one side of which is about 30 feet long. Little need be said with regard to the general arrangement of the switching and controlling gear, as this is clearly shown in the illustrations. There are two cable drums, each having a diameter of 13.1 feet, and arranged in such a manner that the cables belonging to the two cages are separated by a distance of 3.6 feet. Each drum has two grooves; one is for regular service, while the other one is used when a change of cable becomes necessary. The cable

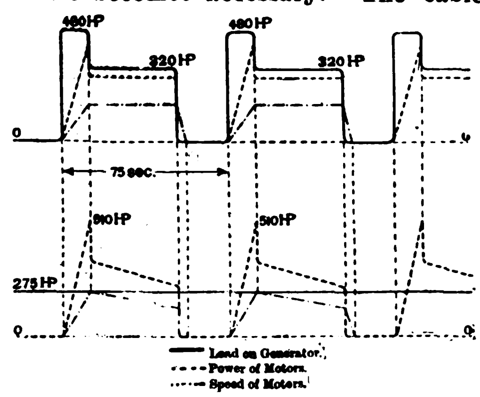


FIG. 2.

itself is of steel, 35 mm. (1.35 inches) in diameter. When hoisting coal in regular service, the two 250 hp. motors which drive directly the upper drum run at a speed of 38 revolutions per minute; but when the plant is used for conveying persons, the speed is reduced to 19 revolutions per minute, corresponding to a hoisting speed of about 12 feet per second; while, for the purpose of examining the shaft, the motor speed may be regulated down to ¾ revolution per minute. When the cage starts its journey the motors have to work at the rate of about 600 hp., but this falls to about 300 hp. when the proper speed is reached. Naturally, these wide fluctuations would, if no other arrangements were made, necessitate a larger generating plant than would correspond to the average power consumed, and in order to level the power demanded to a constant value of about 300 hp. (see Fig. 2), a special set of motors and generators is provided in the

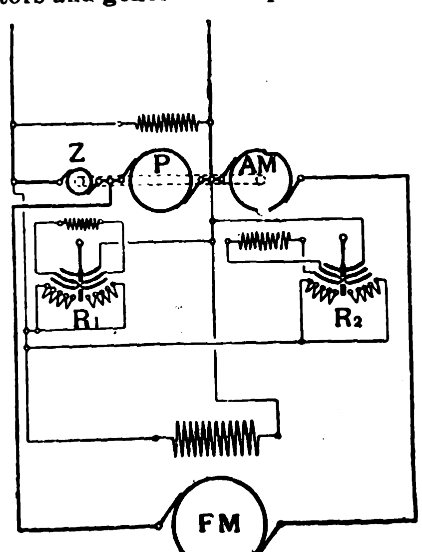


FIG. 3.

central station. A diagram of connections of this power-regulating device is given in Figs. 3 and 4. With reference to Fig. 3. AM denotes a dynamo, termed the "starting" dynamo; P is the so-called "buffer" motor, while Z is a booster. These three electric machines, together with a flywheel, are keyed to a common shaft. When the winding motors, represented by FM in Fig. 3, are at rest, the starting dynamo AM, which is connected in series with the line, has a voltage equal to but opposite in sense to that of the supply. The pressure across the terminals of the hoisting motor is, therefore, at this period nil. When, however, these hoisting motors are to be started, the excitation of the dynamo AM is gradually weakened, the effect being, of course, to increase, proportionately, the pressure of the terminals of the hoisting motors. After the excitation of the

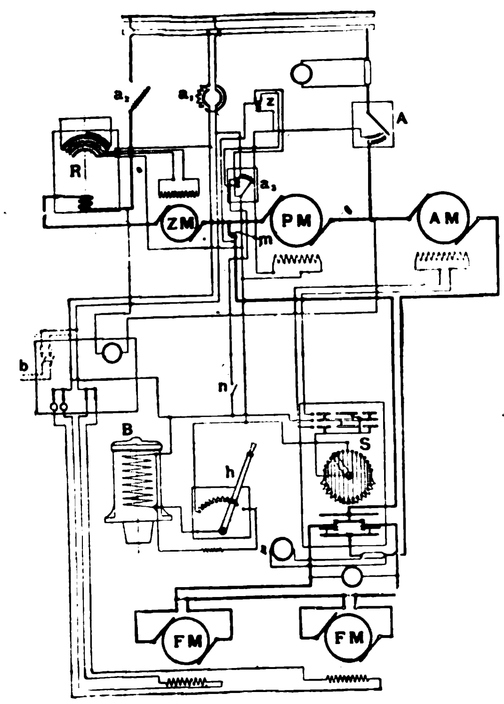


FIG. 4.

dynamo AM has been completely suppressed, the hoisting motors run at half their normal speed. In order, now, to further increase the motor speed, the excitation of the dynamo AM is reversed and gradually strengthened. It is evident that by doing this the pressure of the dynamo is added to that of the supply, the final voltage at which the motors are fed being some 1,050 volts. It will be noticed from Fig. 3 that the motor P which drives the dynamo AM is shunt-excited and connected in series with the booster Z to the power mains. By varying both the value and the direction of the voltage of this booster, the speed of the set AM, P and Z may be regulated within 30 per cent. On reducing the speed of this set, the flywheel gives off some of the energy stored in it, thus reducing the demand on the central station. This variation in speed is controlled automatically by the main current by means

*From the "Electrician," London.

of a regulator. The action of this device is such that the speed of the "buffer set" (as the group of the three machines, AM, P and Z is called) is decreased when the load on the central station increases, and vice versa. In order to stop the buffer set, an electric brake is provided, which is automatically applied should anything go wrong with the bearings.

The braking of the cable drums is done by a double set of brakes applied to the upper drum. Normally, the shoes of this brake arrangement are held against the drum by suitable counterweights. When the brake is to be taken off, however, the counterweights are raised by the action of an electromagnet. It is also possible to operate this brake by hand. The depth indicator is worked through a number of shafts and gears from the lower cable drum. If the driver should neglect to stop the hauling machinery at the proper moment the depth indicator does this automatically by reversing the starting lever and applying the brake. In the case of failure of this device also, there is yet another appliance which will stop the cage before it can rise to a dangerous height. The appliance consists of suitably arranged switches which, when opened, cause the automatic cutouts to interrupt the main current. These switches, of course, are opened automatically when the cage reaches a given height. In front of the operator is a third lever, by means of which the main current can be cut off instantly by hand, the brakes being automatically applied at the same time. A number of automatic devices are also provided for preventing excessive strains, but they are made to operate only after the overload has lasted for a predetermined time. The braking strain of the cable is 65 tons, and the various parts of the winding plant have been calculated on a corresponding basis.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

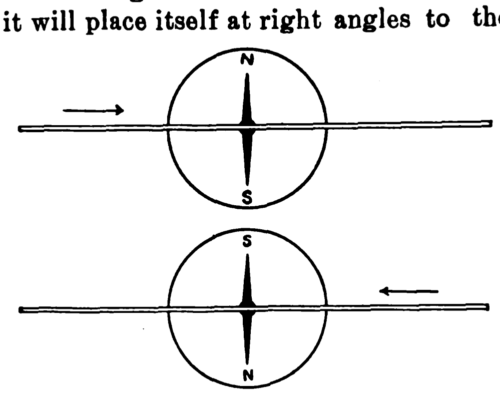
ELECTRO-MAGNETISM.

Oersted's Discovery.—It is customary to term magnetism produced by electricity electro-magnetism, to distinguish it from that which has been produced in lodestones and permanent magnets.

Permanent magnets can be made by electromagnets as well as by the lodestone or other permanent magnets. In fact, the permanent magnet is simply a special case of magnetism retained, while in the production of electro-magnetism, either no iron is used at all or, if employed, it is what is generally known as soft or wrought iron or mild steel—a magnetizable material which does not retain its magnetism permanently. Many expressions are in use in relation to magnetism, such as natural magnets, artificial magnets, permanent magnets and temporary magnets. There are other phrases and words, some obsolete and some modern, which do or did apply to the subject of magnetism. Many of these are unscientific and misleading and it is best to cling to the later and more correct titles of to-day. If magnets are classified, irrespective of other considerations, as permanent magnets and electromagnets, a beginning can be made for a correct practical and theoretical consideration of electromagnetism. The last is what constituted the discovery of Oersted, namely that an electric current produced all the characteristics of a magnet.

Magnetism Around a Wire.—If a copper wire is used to carry a current of electricity from one pole of a battery to another, the entire wire will be found to be surrounded by magnetism. This magnetism, or lines of force, as it is more properly called, can be detected by bringing a compass needle near the wire.

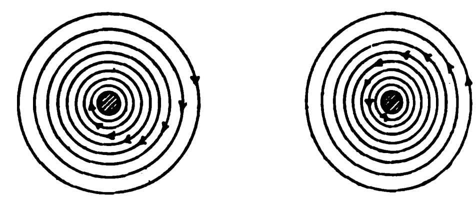
The needle will be affected to such a marked degree and in such a manner that it will place itself at right angles to the



MAGNETISM OF CURRENT FORCING NEEDLE AT RIGHT ANGLES TO WIRE.

wire. Another curious phenomenon will be noticed if the experiment is tried: while the current is flowing in one direction through the wire the needle will hold its position at right angles, as described, but if the current in the wire is reversed, the needle will swing around and although it will settle itself at right angles to the wire in this case as well as the other, it will be discovered that the position of the poles have changed—they have reversed.

If the wire carries a very powerful current and it be thrust through a sheet of cardboard and iron filings scattered around, the presence of concentric circles of filings will be speedily apparent on lightly tapping the cardboard. The presence of magnetism as thus shown, simply proves the existence of a magnetic field whose center is the wire and whose influence extends beyond it. The experiment of reversing the current, however, shows

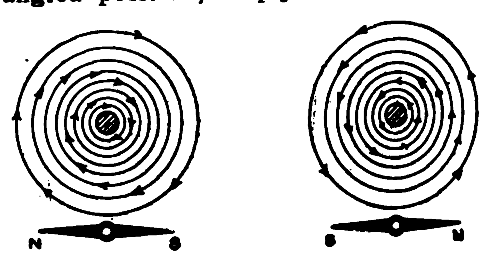


MAGNETIC WHIRL AROUND WIRE CARRYING A CURRENT.

by the reversal of the poles of the adjacent magnetic needle, that the magnetic field around the wire has reversed as well. The wire which carries a current is apparently the seat or vortex of a magnetic whirlpool. The direction of this whirlpool looking at the wire endwise, is entirely a question of the direction of the current. Knowing this as an established fact of the greatest consequence in everyday practice it is not difficult to explain why the needle reverses its poles with the reversal of the current.

Why the Poles Reverse in Position.—The lines of force of a magnetic needle pass out of the north pole and return to the south pole after describing a path through the surrounding space, which can be indicated by means of iron filings. It is only for purposes of convenience that this assumption is made, as either pole may be regarded as the one from which the magnetism issues, provided this pole is distinguished from the other. A wire-carrying current also represents a case where the lines of force surrounding it have a definite direction.

Bringing a current-carrying wire and a compass in close juxtaposition, has the effect of forcing the needle to a right-angled position, simply because the lines



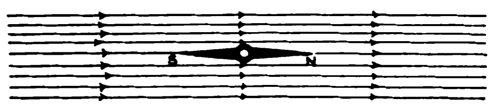
LINES OF FORCE OF MAGNETIC NEEDLE AND CURRENT POINTING IN THE SAME DIRECTION.

of force of the needle instead of opposing each other, place themselves in such a position as to become parallel to each other. The needle, being free to move, responds to this tendency, and thus illustrates the principle that *lines of force tend to set themselves parallel to each other.*

In this particular case the lines of force of the wire direct the position of the

freely moving needle, and its north pole points along the direction of rotation of the magnetic field or whirl around the wire. If the current is reversed in the wire, the magnetic whirl reverses and the needle likewise, in accordance with the principle enunciated.

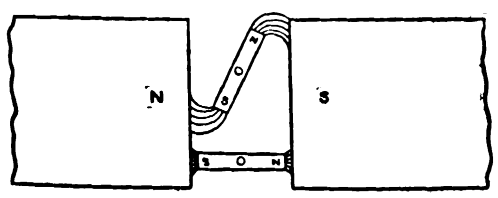
Attractive and Directive Action.—The law, that unlike poles must attract each other, explains the phenomenon of magnetism so far as the actual movement of opposite poles is concerned, but when the action of the earth's magnetic field upon



Magnetism of the Earth Directing the Needle.

a compass needle is considered, it becomes evident that here the action is directive, due to the fact that the lines of force of the earth and the needle set themselves parallel to each other and in the same direction.

When a soft iron bar is placed in a magnetic field, it becomes magnetized through induction, and hence, being for

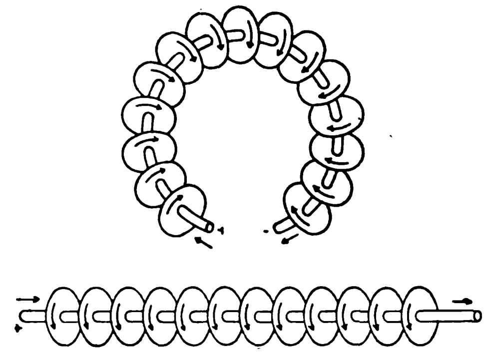


Lines of Force in a Bar Setting Themselves Parallel to the Lines in the Field.

the time a magnet, its lines of force, so to speak, press against or away from the lines of force of the original field and in this way a twisting or turning tendency is developed, forcing or tending to force the bar into a position in which it lies parallel to the magnetic field surrounding it. This directive influence, as well as the actual attraction, are the sources of mechanical energy found in electric motors.

The discovery of Oersted led him to regard a turn of wire carrying a current as the equivalent of a flat magnet of exactly the same dimensions as that represented by the turn of wire.

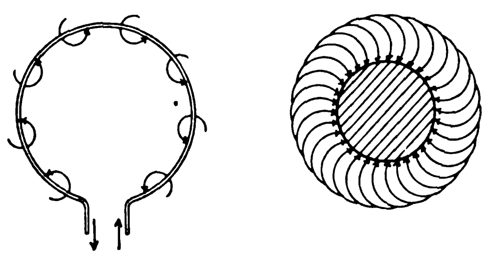
On bringing a compass near a loop of wire carrying a current, the needle will act as if the current-carrying turn of wire were a magnet itself. In fact, this is so; the lines of force surrounding the wire will produce on one side a north magnetic pole, and on the other side a south magnetic pole. The lines of force issue from one side of the loop and pass around through space to the other. The idea can be best represented by a lot of wheels on a metal rod, all rotating in the same direction, whether the rod remains



Mechanical Picture of the Direction of Current and Lines of Force in a Wire.

straight, is bent, or brought around into a loop.

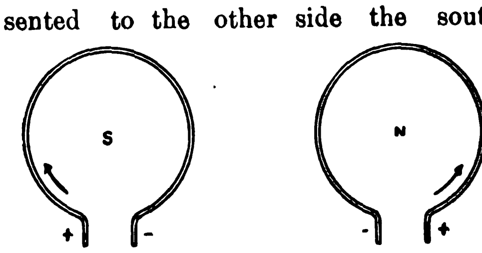
Looking at one side of this loop, the rims of the wheels are rotating outwardly, and on the other side they are entering. In a similar manner the lines of force ceaselessly rotate around a current carrying wire as an axis, only reversing their direction of rotation when the current in the wire is reversed. If the wire remains in the form of a loop, and the current in it is reversed, the direction of the lines of force surrounding it will reverse, and the side of the loop from which the rotation or direction of the



Vortex Ring of Magnetism Surrounding a Current-carrying Loop.

magnetic lines emanates in the first place will now be the side in which they will enter instead of leaving.

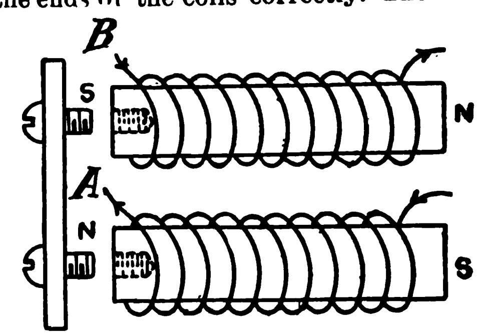
Poles and Direction of Current.—A new and very important fact now presents itself with respect to the loop of wire carrying a current. When the needle is brought near one side, the north pole of the needle is attracted, and when it is presented to the other side the south



Direction of Current and Polarity.

pole of the needle is attracted. If the direction of the current is noted with respect to the direction of motion of the hands of a clock, it will be seen that the current appears to circulate around the wire loop from one side in a direction *opposite* to the hands of a clock, and from the other side *with* the hands of a clock. In other words, the direction of flow of the current will be dependent upon the end of the coil nearest to the point of observation. If the following facts are associated together: the direction of the current, the character of the pole and the movement of the compass needle, it will be found that on that side of the loop where the direction of the current is opposite to the motion of the hands of a clock a north pole appears and conversely, on the other side of the current-carrying loop, the current circulates from its positive to its negative pole in a direction *similar* to the movement of the hands of a clock. Here then is a means of predetermining the north or south pole of a coil with reference to its winding and the flow of the current: *with* the hands of a clock a *south* pole, *opposite* to the han s of a clock, a *north* pole.

Winding Magnets.—The winding of magnets is a little ahead of the principles underlying their construction, but the method of obtaining two different poles becomes merely a question of connecting the ends of the coils correctly. The illus-

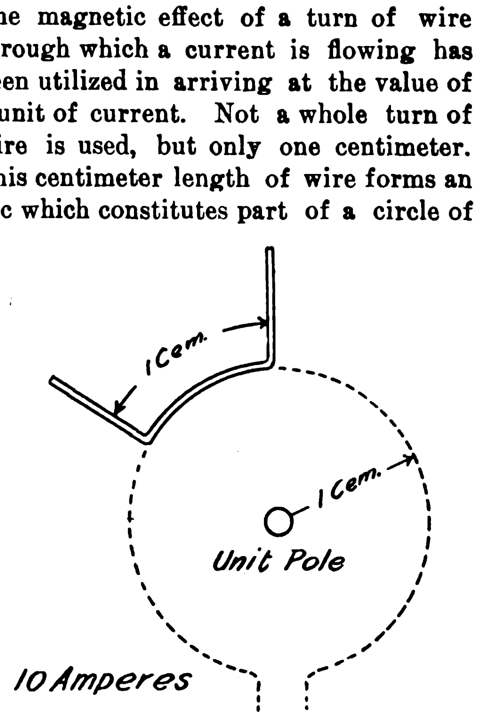


Method of Connecting Up Magnets.

tration shows two cores wound with a single layer of wire to exemplify the principle. Here all the elements of the ordinary magnet are found: two soft iron cores and the connecting bar of soft iron or keeper with screws to hold them tightly in place. The idea embraced by the winding is to show that on both cores the winding is wound in the same way. This would require the two end wires A B to be twisted together to give opposite poles at the ends of the cores respectively. The coils of wire may be wound on sleeves, and then after soaking in melted paraffin or shellac slipped off, and put aside for future use. In this manner a great many coils can be prepared for magnets before they are assembled. It is only necessary to see that when they are slipped on the cores the windings all begin at the same end. If the direction of the current is traced in the illustration given, it will be seen that the polarity is indicated on the basis

previously stated. If the coils of a magnet are not placed or wound so as to bring together the ends most conveniently connected, then the only recourse is to trace the direction of the current carefully and connect the ends together that will give opposite poles even though wires are connected from the opposite ends of each coil.

How a Unit of Current is obtained.—The magnetic effect of a turn of wire through which a current is flowing has been utilized in arriving at the value of a unit of current. Not a whole turn of wire is used, but only one centimeter. This centimeter length of wire forms an arc which constitutes part of a circle of



Obtaining an Absolute Unit of Current.

one centimeter radius. In other words, if a circle of wire is constructed of unit radius, and if only unit length of this circle of wire is employed to carry a current, then when the current in this one centimeter of wire of one centimeter radius is sufficiently strong it will exercise a magnetic force on a unit magnetic pole equal to one dyne. The current which is able to exercise a force of one dyne in a centimeter of wire of one centimeter radius upon a unit north pole placed at the center, is a current of 10 amperes. The absolute unit of current is not the unit commonly employed, equal only to one-tenth of the absolute unit and called 1 ampere.

The development of a mathematically exact quantity of force by every equal length or portion of a wire carrying a current of uniform strength when brought near a unit pole is one of the fundamental propositions of magnetism. It is easy to realize that the final accomplishment in the dynamo is that of overcoming a resisting magnetic force by means of mechanical energy and, on the other hand, in the motor it consists in the development of mechanical energy by the interaction of magnetic forces.

THE PREDETERMINATION OF THE DEMAND FOR ELECTRIC LIGHTING IN MODERATE-SIZED TOWNS.

In an article by F. Erens in a recent number of the "Elektrotechnishe Zeitschrift" an interesting connection between the demand for electric lighting in a given town and the prosperity of its inhabitants is shown to exist at least in the case of certain moderate-sized German towns. The writer, being confronted with the problem of deciding beforehand the probable lighting output required by a town of 60,000 inhabitants, attempted to obtain an average figure by investigating the records of numerous other towns. He found, however, that, taking the 1902 statistics of German towns having between 30,000 and 150,000 inhabitants, the results differed very decidedly, the extreme values being, respectively, 3 kw. and 25 kw. per 1,000 inhabitants. The higher values might be due to the high price of gas lighting, the low price of electricity, to special expedients employed by the station engineers or to general economical conditions, and in order to arrive at some satisfactory arrangement a circular letter was addressed to the authorities of ten of the towns which, in spite of a comparatively short time of service, had attained very high values for the lighting output. In this letter special inquiry was made as to the causes of the high values, and as to any special means adopted for raising the value. The replies showed that the price of gas in these towns was in no way unusual as compared with that of electricity. The authorities also placed little weight on the special means adopted (which consisted chiefly in the free installation of houses or their installation under easily fulfilled conditions), but all agreed that the chief cause of the high value lay in the financial condition or prosperity of the inhabitants.

In order to investigate this point, the writer assumed that the prosperity of the inhabitants was proportional to the income tax per head paid to the State. This assumption is only correct when all the towns are taxed under a uniform law and on the whole of the incomes, and these conditions applied to the Prussian towns alone. As, besides this, all towns of more than 150,000 or less than 30,000 inhabitants, as well as towns with very widely differing lengths of service, had to be excluded, the comparison could only be applied to a small number of towns. In the curve (Fig. 1) the towns are arranged so as to form a rising curve of kilowatts per 1,000 inhabitants (shown by the angular solid line), and the values of the income tax in marks (shillings) per head are shown to the same scale of ordinates by the small circles. The dotted line is the approximate average for these circles. It will be seen that the one curve practically lies over the other, so that the two following conclusions may be drawn: (1) The prosperity of the inhabitants of a town is a measure of the

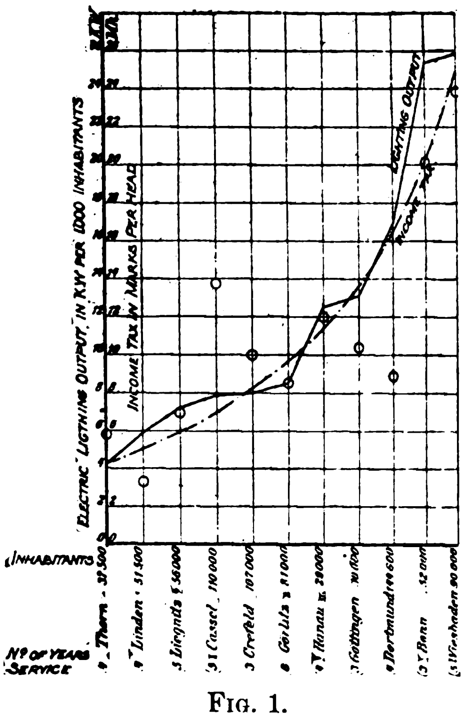


Fig. 1.

electric lighting output; (2) the value in marks of the income tax per head under the Prussian law is, in the case of medium-sized towns, approximately equal to the kilowatts per 1,000 inhabitants used in electric lighting after 5 or 6 years' service. The latter rule, of course, cannot claim to represent the facts exactly, but the curves given may be of some service in deciding the probable relative values of the electric lighting outputs in different towns.—"Electrical Engineer," London.

THE MAXIMUM DISTANCE TO WHICH POWER CAN BE ECONOMICALLY TRANSMITTED.*

BY RALPH D. MERSHON.

The problem of power transmission is one depending upon the distance over which power can be economically transmitted. It involves the double question of transmission voltages and the distances they can adequately and economically reach in a purely commercial sense. It is not believed that present methods of power transmission will so materially change that assumptions of the character

*Digest of paper read before the American Institute of Electrical Engineers, New York, Dec. 23, 1904.

to be made will be discarded for many years to come. The distance in power transmission is limited from a business standpoint by the cost of electricity at the power house, and the price received for it at the distant end of the line. From this gross profit must be deducted the interest on the total investment and the cost attached to the transmission of the power. The balance represents the net profit. The cost attached to the transmission of the power embraces such items as—power wasted in the line, the expense due to the operating plant and elements of cost which comprise repairs and maintenance. The distance of transmission is governed by the amount of profit anticipated from the enterprise and the total interest to be paid annually. This means that those plants to be operated over the greatest distance are plants where interest charges are low and the stock dividends at a low figure as well. If the output of a plant is great the cost per unit of power is less than when the output of the plant diminishes. In other words, with a given power transmission plant where the drop, distance and number of volts employed to send the power are known, the cost of the machinery and its indispensable accessories as compared with the cost of the line wire increases less rapidly than the cost of the line with increased output at the station. If the plant produces more power each kilowatt of power costs less with respect to everything constituting the equipment but the line. It is in the line, therefore, that losses systematically increase with increased power and distance from the station. To offset this, to some extent, is the gain in diminished cost of the power when the load is increased, but still the cost of a kilowatt per annum, if the line reaches out further, increases as this distance increases because of the proportionately greater weight of copper in the line. How can this be obviated? Only by raising the voltage. While this appears a simple and relatively inexpensive process yet it also has its drawbacks, though not exactly those generally anticipated, such as leakage, difficulties in construction, etc. The drawbacks are those due to the increased cost of high-grade insulators and properly constructed transformers for receiving unusually high electromotive forces.

This reduces the problem of power transmission down to the basis that the limiting distance to which power can be economically transmitted will depend wholly upon the cost of the line conductors.

The pressures indicated by a survey of the situation from such standpoints as these, which can be economically employed, may reach as high as 200,000 volts for a power delivery of 500,000 kw. (more than 650,000 hp.).

The immediate future points to the transmission of from 200,000 to 300,000 kw. at pressures of from 125,000 to 175,000 volts. The distances that could be covered would be 512 miles with 200,000 kw. to transmit and 623 miles with 300,000 kw. to transmit.

The conclusions reached are that about 500 miles is the limiting distance, judging from practical and theoretical considerations, and that the range of high voltages is entirely governed by such economical considerations as relate to the transformers and insulators.

According to certain theoretical considerations the cost of an insulator varies with the pressure in volts and the diameter of the conductor, but in practice this last relationship does not hold and the cost of an insulator for high tension plants is found to vary with the cube of the voltage multiplied by the distance of transmission in miles. The transformer cost, on the other hand, varies with the output and voltage.

PARIS–ORLEANS ELECTRIC RAILWAY EXTENSION.*

(*Concluded from page 346.*)

Among the changes in the power station occasioned by the extension is the removal of the entire switchboard from its old position, to install it on the opposite side of the power station. The switchboard has been increased by a number of panels bearing instruments of similar pattern to those already installed. A notable addition is a certain number of synchronism indicators, replacing the old synchronizing voltmeters, plugs and lamps.

On the new switchboard, potential transformers are provided for an 11,000 volt circuit, and the oil switches, cut-out switches and other apparatus for the line panels are also arranged, where practicable, for the same voltage, which is to be ultimately used when the line is further extended. The present three-phase 25-cycle voltage is but 5,500, as already explained.

The usual indicating voltmeters, ammeters, wattmeters and power factor indicators are provided, together with their necessary transformers.

A new chimney stack, 50 m. in height, has been provided, and for the four new boilers are included two Green economizers, each of 224 tubes.

Two new sub-stations have been built —one in the power station itself, at Ivry, and the other at Ablon, close to the present station at Juvisy. The original sub-station at Austerlitz has been removed, and the traction and lighting machinery has been distributed as follows: One of the two 250 kw. converters used for traction has been installed at Ablon sub-station. The remainder of the apparatus has been removed bodily to the new Ivry sub-station, and the battery has been increased to 290 cells.

Two new 500 kw. rotary converters have been installed in Ivry sub-station, together with transformers and reactances. The converters are six-pole, six-phase, 500 r.p.m., taking three-phase current at 440 volts, and giving a pressure of 625 volts d. c.; they are compound wound, with the series winding reversed. They are designed to give a total output of from 400 to 500 amperes per machine, loads above this being divided between the machine and the battery. The transformers are of the air-blast type, six-phase 550 kw., stepping down the 5,500-volt three-phase current (25 cycles) to 440 volts. These transformers are also arranged to transform 11,000-volt, three-phase current to 440 volts, as the higher voltage will be used when the lines are prolonged as far as the more distant point of Bretigny, 13 km. beyond Juvisy, the present terminus.

The underground transmission cables are very similar to those installed for the first portion of the line in 1900. The extension includes some 25 kilometers of three-conductor paper-insulated lead-covered and steel-armored cable. This cable is laid entirely underground, in duplicate, to avoid chances of breakdown. These two lines are usually operated in parallel. They are cut into three equal sections, and section boxes are provided at these points containing static discharges, oil switches and meters. The section of each conductor is 80 sq. mm., against 50 to 75 sq. mm. in the original cables for the first portion of the line.

The cables are capable of carrying three-phase, 25-cycle, 11,000 volt current, to be used later. The tests made on the cables were at 30,000 volts, 50 cycles, between conductors and between conductors and ground during two hours, the voltage being raised then to 40,000 volts for two seconds. Further tests were also made after the cables were laid in the ducts.

It will be seen from the foregoing that there is no fourth rail, and the track is

*From the "Electrical Review," London.

used as a return circuit. The track has been bonded with about 25,000 bonds of a cross-section of about 112 sq. mm. The whole of the track is used as a return, and is bonded accordingly. At points and fixed crossings, where flexible bonds are unnecessary, copper ribbon bonds are used.

The third rail is bonded in two ways. One bond is used to connect the ends of the third rails, and the other bond connects the ends of the fish-plates, which run the whole length of the third rail. About 8,000 bonds have been used on the new third-rail extension, which differs somewhat from the original construction. The section of these bonds is about 220 sq. mm.

The third-rail insulators are formed of impregnated and tarred blocks placed on the ends of the sleepers, spaced about every 20 meters, where a clear run is to be had. At crossings, and also in and around stations, the third-rail is protected by vertical and horizontal wood sheathing painted white and red. The weight of third-rail and continuous fish-plates is about 104 kg. per meter length.

The overhead inverted "T" rail is not used on the new extension, the third-rail meeting all requirements.

The Orleans Railway Company has built new stations all along the line and increased the tracks, making four in all running to Juvisy, the outside two being used for the electric traction.

A certain number of through or "rapide" trains run to Austerlitz without changing locomotives at Juvisy, the latter operation taking place at Austerlitz before the train leaves for Quai d'Orsay. The majority of the trains, however, have their locomotives replaced at Juvisy.

The new service to be handled is as follows: The number of trains to be hauled from Austerlitz to Quai d'Orsay will be about 150 daily, thus continuing the old service. This number includes all main line trains, and a certain number of local trains. The time, as before, will be about 8 minutes, not including the intermediate stop. The two trains equipped with multiple unit control will make the shuttle service between Paris and Juvisy, and will be supplemented by a certain number of trains per day drawn by locomotives which also stop at all stations to Juvisy, but proceed further in charge of steam locomotives.

A number of express trains will make the journey Paris–Juvisy, and vice versa, in 17 minutes, a change of locomotives being made at the latter station. The time taken by the all-station trains is about 25 minutes, exclusive of six stops of one minute each.

The number of locomotives on the service will be 10, of which one is reserved for station work. The eleventh locomotive is supposed to be under repairs or being cleaned. There are five motor cars, one being held in reserve.

For the local traffic a half-hourly service is expected to be maintained, supplemented by a certain number of trains at business hours. The grades and curves on the extension are negligible.

THE AMERICAN DIESEL ENGINE.*

BY E. D. MEIER.

Many of your members will remember certain papers published some years ago in regard to the merits of a new invention in prime movers, called the Diesel motor.

The claims set forth as to the economy of this device were so large and far-reaching, that most practical men received them with a shrug of the shoulders. They were, nevertheless, not only true, but somewhat understated. From the small Diesel motor of 20 hp., which gave these remarkable results, has grown by natural process of evolution the American Diesel engine of to-day, at present built in sizes from 75 hp. to 450 hp.

A short explanation of the working of this engine may be permissible, as many, no doubt, have forgotten the former explanation, while to others the matter may be entirely new.

The Diesel engine is essentially an oil engine, and not a gas engine. Gas engines and previous oil engines, which acted on the gas engine principle, have all in common the explosion of a charge. This charge is a mixture of a given quantity of gas, or a given quantity of oil vaporized so as to act as a gas during the process, combined with a quantity of air, varying from seven to eleven times the volume of the gas or vapor. It was well known that some previous compression would add to the economic results of the explosive action. But in all cases the power was obtained by an explosion which, from the moment of ignition, was beyond the control of the operator or of the governing mechanism of the engine. This fact limited the efficiency of all governing devices which could be applied, and troubles with the ignitor caused other irregularities, so that even where local conditions made the gas engine (or vaporized oil engine) the worthy competitor of the steam engine, uncertainties of its operation threw doubt on the wisdom of the substitution.

Furthermore, a cheap gas, necessitating the installation of a large and cumbersome producer plant, was the only escape from such costly fuels as gasoline or kerosene.

The Diesel engine made the use of the cheapest liquid fuel, such as crude oil, fuel oil, and distillates possible. To these recent experimental developments promise to add the product from gas works, known as light water gas tar.

The Diesel engine works on an entirely new principle. First of all, it dispenses with the so-called charge or mixture, which in all explosive engines must vary only between the limits of one gas to seven air and one gas to eleven air. Its cycle is the same as the gas engine, the well-known Otto cycle. There its similarity with the gas engine ends absolutely; in everything else it follows the precedent of the steam engine.

Its first stroke is a section stroke, drawing a cylinder full of pure clean air; on the second stroke it compresses this to a tension and consequent temperature sufficient to ignite any fuel which may be injected into it; at the beginning of the third stroke a small quantity of fuel oil is injected into this red hot air as a spray by a jet of highly compressed air, and thus in a completely pulverized state the fuel meets and mixes with the hot compressed air in the cylinder, burning completely, and during a period of time exactly regulated by the governing mechanism of the engine, generally through one-tenth part of the stroke, subsequent to which the stroke is finished by the expansion of the burnt products; the fourth stroke discharges these products of combustion and leaves the cylinder empty and ready for another suction stroke.

It is evident that the work expended in compressing the cylinder volume of pure air, is given off again to the shaft of the engine during the combustion or motor stroke, so that the loss is simply the frictional loss during the compression stroke.

This simple process, absolutely new and original with Diesel, has enabled him to accomplish with one-half pint of common crude or fuel oil as much as the explosive engine does with a full pint of the much more expensive gasoline.

A recent comparison of results extending over a period of regular daily service of six weeks has shown the consequent economy of the Diesel engine over a first-class gasoline engine, which it displaced, of 600 per cent.

The modest statement set forth some

*Paper read before the American Street Railway Association at its 23d convention held at St. Louis, Mo., October 12-13, 1904.

years ago by the promoters of the Diesel engine, and covered by absolute and binding guarantees, are that 100 hp. hours measured in the crank shaft of the engine will require not exceeding eight and one-half gallons of crude or fuel oil when the engine is running at or near its greatest capacity nor more than nine and one-half when it is running at or near half-load. The Diesel engines which are furnishing all the electric light and nearly all the power for the German Tyrolean Alps at the World's Fair, St. Louis, furnish 100 hp. hours on the switchboard while running at loads varying during the day from one-quarter to full load with a consumption of only seven and one-half gallons of common fuel oil from Whiting, Ind. At three cents per gallon this means a 100 hp. per hour at two and one-quarter cents or 100 kw. per hour at three and fifteen hundredths cents. While in some localities such fuel oil or crude oil, delivered in carload lots, may cost as high as four cents per gallon, it is readily furnished in many localities contiguous to oil fields at three cents and even two cents per gallon.

The regulation in the Diesel engine is not dependent on hit or miss, but can be followed up or down the scale as closely as in a steam engine. In the latter it is a question of cutting off more or less from a pretty large volume of steam at each stroke; in the Diesel engine it is the finer one of cutting off a more or less minute quantity of oil from the small volume delivered by the fuel pump at each stroke. It is accomplished by direct action of the governor on the suction valve of the fuel pump, which is held open during a greater or less portion of the pressure stroke, and thus the pump delivers the exact quantity of oil required during each motor stroke of the engine. While the mechanism is necessarily smaller, and more delicate than in the steam engine, it also requires less power and its effect is more immediate.

In a compound steam engine the volume of steam left in the high pressure cylinder at the point of cutoff must be used in the next stroke of the low pressure cylinder whether at the time more or less would be the proper quantity for that stroke. In the Diesel engine the regulation acts on each cylinder just at the time and in the exact quantity then required.

There remains only the drawback common to all four cycle engines, that there is but one motor stroke for every two revolutions. For electric light work triple cylinder engines and heavier fly-wheels successfully overcome this, while for electric railway work resort is had to still larger fly-wheels and six cylinders by coupling two triple cylinder engines at the two ends of the dynamo shaft.

As for the accessibility, reliability and durability of the engine, three years of experimental work have placed these fully on a par with the best steam engine practice, and since then two years and in some cases nearly three years' of continuous service by a number of Diesel engines of the New American type give sufficient examples of the success in this work.

COALING AT SEA.*

BY P. C. FERGUSON.

The present war between Russia and Japan, and, in particular, the sailing of the Baltic fleet for the scene of hostilities in the Orient, not only show the importance of having numerous coaling stations, which must be strongly fortified and garrisoned and made self-defending, but also indicate the necessity of having ample means for coaling at sea when great distances must be traversed and when neutral harbors are not open for coaling purposes.

Many plans have been proposed for coaling ships at sea, a large part of which are considered unsafe by prominent engineers. During a heavy sea it is generally considered unsafe to employ broadside coaling; and the "end-on" system of cableway plant is usually employed. In order that this system may be safe, experienced engineers maintain that a good distance must be provided between the battleship and the collier, 400 feet being considered a minimum by conservative experts, while no connecting line should be made fast to both ships except the tow-line, so that, in the event of the tow-line parting, the lines of the cableway would clear themselves.

A marine cableway permits a fighting vessel to stay in the fighting line, and allows a fleet of war vessels to arrive off the enemy's coast with bunkers full instead of being displenished. No navy can have too much coal, or too many ways of obtaining it, in time of war.

One of the most important improvements in coaling ships under the marine cableway system, has been in the method of delivering the coal after it reaches the deck of the vessel. Until recently, as on the U. S. S. Massachusetts, a pair of shears were erected and guyed, supporting a large canvas chute, through which the bags of coal were dropped. This has now been dispensed with in some instances; and the ropes of the cableway are pulled down by means of a "nigger-head" on the quarter-deck winch at the time it is desired to dump the load.

*From the "Technical World," Chicago.

In harbor coaling, nigger-heads are used, and they will hoist 2,240 lbs. at the rate of 300 feet per minute. The slipping drum will develop a rope speed of about 1,700 feet per minute, and will lift a load of half a ton. These winches operate the load carriage between the collier and the warship, one winch carrying the loaded carriage toward the warship, the other drawing the empty carriage back to the collier. For this purpose, a single wire rope, about 2,000 feet in length and ⅝ inch in diameter, is employed. In many cases both winches are operated by electric motors, and run all the time in the same direction, the ropes being always taut. The friction of one slipping drum overpowering the other gives the reciprocating motion to the load carriage. The rope is being wound up on the drum of one winch, while it is being paid out by the other drum under tension through the slipping of the friction head, the heat developed by the slipping being dissipated by air passages and radiating fins.

It is stated that this method of operating a load carriage is independent of the relative motion of the two ships, since, when the ships pull apart, one drum slips, thus paying out rope, while the slack given to the rope is wound in when the ships approach each other. It is essential, however, that the rope speed of these winches be greater than the speed at which the ships approach each other.

It may be of interest to note some details of the electrical equipment of one of the Russian battleships for taking a supply of coal while at sea.

The ill-fated battleship Retvizan, disabled by the Japanese at Port Arthur, was equipped with the Lidgerwood-Miller marine cableway, which is an American system of coaling at sea. This system is operated by two electric winches, the slipping drum being mounted on the armature shaft of the electric motor. The drum has a diameter of 14 inches, and gives a rope speed varying from 1,200 feet per minute at full load to 2,000 feet per minute at half load. The first warship to be completely equipped with the marine cableway, was the U. S. S. Illinois. Its equipment will permit that battleship to take coal at sea from any masted vessel that it may meet in any quarter of the globe. The British collier Muriel, on several sea trials, delivered from 35 to 40 tons of coal per hour in a moderate sea and half a gale of wind to H. M. S. Trafalgar. The battleship towed the collier

at speeds varying from eight to eleven knots an hour. The same collier also coaled H. M. S. Empress of India at sea at the same rate; and at one of the English trials, Vice-Admiral Sir G. H. Niel had his fleet of seventeen ships witness the operation for the benefit of the officers on board.

By having warships equipped in this way, it is claimed that the question of coal supply is largely solved, since vessels can coal directly from any collier and are not dependent upon coaling stations. Any masted ship, either sailing vessel or steamship, can do duty as a collier, and deliver its coal at sea to any warship equipped with a marine cableway. Even a destroyer could be coaled at sea by a collier, when properly equipped. Capt. E. M. Shepard, U. S. N., lighthouse inspector at Tompkinsville, N. Y., has stated that "out of 365 days ending November 30, 1900, the log book of the Sandy Hook light-vessel shows that the sea was smooth 121 days, moderate 196 days, rough 47 days, and very rough one day." It is claimed that coaling at sea could have been accomplished 317 days out of the 365 off Sandy Hook.

The load starts out from the collier on a down-hill route, continuing so for more than half the distance. When the load is just clear of the center of the span and in its lowest position, the man on the quarter-deck of the warship commences to pull down the block. By the time the bags reach the haul-down block, they will be trailing on the deck. The operator will stop for an instant, the lowering will continue for a foot or more, the load will be unhooked from the carriage, the empty bags put on, and the whole allowed to rise to its normal position. At the same time, the operator on the after-bridge will send the empty carriage back to the collier for another load by means of the electric winch above referred to.

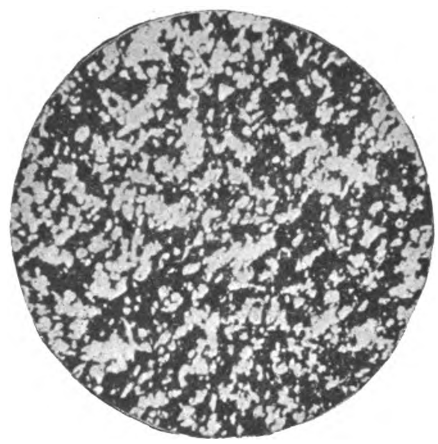
The Cause of Friction and the Theory of Graphite Lubrication.

The resistance to free motion offered by surfaces in contact we call friction.

It is due solely to the roughness and unevenness of the surfaces in contact. Whereas it may be possible to produce what appears to the unaided eye as "a perfectly smooth surface" on metal, an examination under a powerful lens or microscope will invariably reveal a very different condition of affairs. When so magnified some metals appear granular, some lumpy, same crystalline in a variety of shapes and some quite fibrous.

The illustration shows a small area of an ordinary smooth "babbitted" surface, greatly magnified, emphasizing our major premise that "a perfectly smooth metal surface exists only in theory or imagination."

When two metal surfaces are brought into sliding contact these minute elevations and depressions interlock and resist free motion, the greater the pressure the greater the resistance. If force be applied to surfaces thus in contact the irregularities of the surfaces must ride over one another or the minute projections be broken off. When this occurs we have continual abrasion and all of the energy thus absorbed is converted into heat.



PHOTOGRAPH OF BABBITT METAL (MAGNIFIED).

Lubrication consists in separating the bearing surfaces by a layer of some other material, in machinery commonly an oil or grease thick enough to prevent the minute irregularities from even touching. The thicker or more viscous the lubricant, the thicker film will it form; but also the more viscous the lubricant the greater its own "internal friction." Oils and greases must not be too thick, especially where the speeds are high. It is a safe rule to follow to use the thinnest oil or grease that will keep the surfaces apart and keep the bearing cool.

A cardinal principle in lubrication, evident from the foregoing, is: "The smoother bearing surfaces can be made the less friction will be encountered and the easier will they be to lubricate."

The principle is emphasized by the action of flake graphite in filling up the minute depressions, roughnesses and pores in metal surfaces, bringing them much nearer to a condition of perfect smoothness, which brings about a great reduction in the "solid friction" between those surfaces. Graphite, with its strong tendency to attach itself to metallic surfaces, imparts a veneer of marvelous smoothness and great endurance that materially reduces the necessity of a thick oil film and effects a double reduction in friction.

This will be most readily understood from a glance at the following diagrams, which picture in exaggerated degree the condition of every bearing surface.

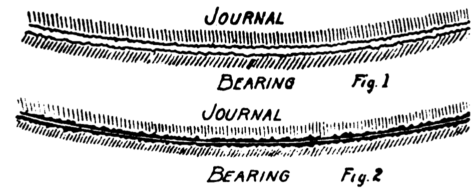


Fig. 1 shows ordinary friction surfaces, separated by a comparatively thick film of oil, while Fig. 2 illustrates the manner in which graphite overlays the roughnesses, making a surface of exceeding ing smoothness that allows the use of a thinner lubricating layer.

Thus, in a word, the lubricating effect of graphite is to provide so perfect a surface that the oil film may be thinner and of thinner oil. Hence there is an apparent and logical reason for believing that flake graphite will reduce friction.

Graphite attacks friction at its cause, whereas oils and greases are simply makeshifts to keep relatively rough surfaces apart, and that, in most cases, only indifferently well. It is when flake graphite and oils and greases are used together—the graphite to perfect the surfaces, the oils to provide the separating layer—that, in general, the best results are to be obtained.—"Graphite."

Energy—British, American, and Japanese.

A lecture entitled "Energy—British, American, and Japanese," was given by Prof. W. E. Ayrton at the Municipal School of Technology, Manchester, England, on January 3. Analyzing the causes of the superior efficiency of the American, Prof. Ayrton spoke in detail of the invigorating climate, the widespread enthusiasm for education, and the longer working hours. As to the willingness to adopt new ideas, this was a most marked feature of American industrial methods, and it contrasted with the British attitude towards novelty. Initiative was taught in America from child hood. In education "the greatest importance is attached to what a boy and girl are on leaving school than to what they know." Speaking of the superiority of American machinery, he explained the slowness of the British manufacturers to adopt up-to-date plant as due to their not having realized that a diminished cost in production furnished a high rate of interest on any capital invested in improved machinery, and to the opposition of the workmen to machinery. The men had thought that the masters, and not they,

would enjoy the benefit of the new methods.

There was still the same stubborn resistance, fostered by the same opinion that work was a certain fixed quantity, and that therefore it ought to be dealt out sparingly, like food to a shipwrecked crew. "Not merely can the cost of production be greatly decreased by the use of new methods of manufacture, but the amount of work to be done can be greatly increased by starting new industries. The difference is this—to make money an Englishman cautiously saves, an American boldly earns." Prof. Ayrton condemned the employment of prizes and profit-sharing as an incentive to workmen, likening it to an attempt to make soldiers fight by appealing to their love of booty. The special characteristic which was the moving spirit in America, and which was the secret of the marvelous development of Japan, was not love of money, but energetic, enthusiastic patriotism.

Franklin Institute Election.

The annual election of officers and committees of the Franklin Institute was held last week in Philadelphia, Pa., where the following officers were chosen: President, John Birkinbine; vice-president, Washington Jones; secretary, William H. Wahl; treasurer, Samuel Sartain; auditor, Dr. William H. Greene; managers: Edwin S. Balch, Walton Clark, Thomas P. Conrad, Charles Henry Howson, Louis E. Levy, Charles Longstreth, Isaac Norris and Coleman Sellers. The Institute's Committee on Science and the Arts for the new year consists of A. W. Allen, Hugo Bilgram, Amos P. Brown, Frank P. Brown, W. W. Canby, Kern Dodge, W. C. L. Elgin, Daniel Eppelsheimer, Jr., E. Goldsmith, Lewis M. Haupt, Lucien E. Picolet, C. J. Reed, James S. Rogers, Harrison Souder, George P. Scholl, E. Alexander Scott. Mr. Sellers, H. W. Spangler, A. H. Stewart and Martin I. Wilbert.

Would Build Trolleys in St. Petersburg.

It is reported from Pittsburg that Murray A. Verner has gone to St. Petersburg to renew his efforts to secure the rights and franchises for the construction of an electric street railway system in the Russian capital.

A Lubrication Number.

The Joseph Dixon Crucible Company begins the new year with a special issue of their monthly house publication "Graphite," devoted to Graphite Lubrication. This number has been sent to thousands who are vitally interested in lubrication in the hope of leading to a better understanding of the principles underlying the most effective use of Dixon's Ticonderoga Flake Graphite.

Graphite Lubrication is not a mere theory up for discussion. It is a well established fact of modern engineering and growing in importance every day as its advantages become better known Lubrication methods must keep pace with machine and engine construction and steadily, surely, the use of lubricating graphite increases because it aids to better lubrication. Copies of January "Graphite" will be freely sent to all who may be interested in attaining better results in lubrication by the Joseph Dixon Crucible Company, Jersey City, N. J.

America's Winter Resorts.

"The Four-Track Series" of books and pamphlets of travel and education, issued by the passenger department of the New York Central, has become a standard series with travelers, containing as they do such a large and varied amount of information.

No. 5, " America's Winter Resorts," just received from the press, is especially valuable, as it contains a map of the United States, a portion of Mexico and Central America. as far as the Panama Canal. It also gives sections of the Panama and Nicaraguan Canals. There is also a map of the Hawaiian Islands, and an outline map of North and South America including the West Indies.

There is also a map of the Pacific Ocean including various American routes from the United States to Australia, New Zealand, the East India Islands, the Philippines, Japan and China, with a large amount of information in regard to winter resorts to visit, with the rates of one way and round trip, and a brief description of some of the principal points.

A copy of this folder will be sent free, postpaid, to any address on receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

Catalogues Wanted.

W. D. Edwards, of the Randolph Building, Memphis, Tenn., wants catalogues from builders of machinery, engines, boilers, electrical equipment, etc., for all kinds of manufacturing plants.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DEC. 20, 1904.

Electric Railways and Appliances.

777,691. Trolley-Head. Edwin V. Newcomb, Kansas City, Mo. Filed Dec. 15, 1903.

777,693. Electric Locomotive. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company. Filed May 6, 1904.

777,698. Trolley Head and Wheel. Joseph W. Sharp, Mohawk, N. Y. Filed March 4, 1904.

777,707. Insulated Joint. George A. Weber and Percy Holbrook, New York City, assignors to the Weber Railway Joint Manufacturing Company. Filed Nov. 13, 1903.

777,912. Trolley-Crossing. Edward R. North, Webster Groves, Mo. Filed May 6, 1904.

777,972. High-Speed Permissive Train System and Apparatus Therefor. Thomas H. Patenall, Wilkinsburg, Pa., assignor to the Union Switch & Signal Company, Swissvale, Pa. Filed Sept. 19, 1902.

778,017. Trolley-Guard. Mack H. Dorsey, Woodlawn, Ala. Filed May 24, 1904.

Electric Lights and Appliances.

777,741. Base for Electric-Lamp Bulbs. George P. McDonnell, St. Louis, Mo. Filed March 12, 1904.

777,871. System for Lighting Hydrocarbon-Lamps. George Washington, New York City, assignor, by mesne assignments, to Joseph N. Patterson, Devon, Pa. Filed Aug. 3, 1899.

778,155. Incandescent Electric Lamp and Switch. George Sweetser, Upper Norwood, England, assignor to the E. C. L. Syndicate, Limited, London, Eng. Filed Feb. 2, 1904.

Electrical Machinery and Apparatus.

777,709. Brush-Holder for Dynamo-Electric Machines. Ernst Woehr, Wilkinsburg, Pa. Filed May 13, 1904.

777,778. System for Controlling Electric Motors. Henry H. Cutler, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, same place. Filed July 6, 1903.

777,801. Electric Switch. William J. Murray, Leavenworth, Kan., assignor of one half to Herbert W. Wolcott, same place. Filed May 2, 1904.

777,833. Static Electrical Machine. Charles F. Birtman, Chicago, Ill. Filed Feb. 6, 1904.

777,839. Motor-Starter. Eugene R. Carichoff, East Orange, N. J., assignor to the General Electric Company. Filed May 12, 1904.

777,844. Meter. Frank P. Cox and William H. Pratt, Lynn, Mass., assignors to the General Electric Company. Filed Jan 29, 1903.

Telephones and Telephone Apparatus

777,764. Telephone-Call Register and Time-Indicator. David A. Yoder, Toledo, O. Filed April 27, 1904.

777,807. Telephone System and Apparatus. Elias E. Ries, New York City. Filed June 23, 1899.

777,808. Telephone Transmitter. Elias E. Ries, New York City. Filed June 23, 1900.

777,954. Telephone-Chair. George J. Just, Northbranch, Ia. Filed Aug. 15, 1902.

Miscellaneous.

777,750. Apparatus for Indicating the Magnetic Condition of Heating Metals. George W. Sargent, Reading, Pa., assignor to the Carpenter Steel Company, same place. Filed July 11, 1904.

777,760. Automatic Signal System. John R. Walsh, Boston, Mass., assignor of one-half to Henry T. Goold, Lexington, Mass. Filed Feb. 19, 1904.

777,851. Electric Battery. William H. Gregory, Vallejo, Cal. Filed May 14, 1904.

777,867. Photometric Apparatus. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed July 31, 1901.

777,883. Control System. Eugene R. Carichoff, East Orange, N. J., assignor to the General Electric Company. Filed June 2, 1904.

777,974. Electromotive Device for Clocks. David Perret, Neuchatel, Switzerland. Filed May 27, 1904.

777,991. Device for Projecting Air Against Electric Discharges. Ernest E. Werner, St. Louis, Mo., assignor to the Electrical Purifying Company, Stafford, Kan. Filed Aug. 29, 1904.

778,005. Electric Insulator. Charles Booker, Toronto, Canada. Filed Feb. 1, 1904.

778,067. Telegraphic Key. John E. Pearson, Motor, N. C. Filed Nov. 12, 1903.

778,194. Electric Furnace. Henry M. Howe, New York City, assignor to Elmer & Amend, New York City. Filed Oct. 3, 1902.

778,206. Electric Hammer. William F. Wagner, New York City. Filed July 11, 1904.

THE TELEPHONE WORLD.

Independent Lines Secure Long-Distance Connection.

Cleveland, O., Independent telephone interests will soon be able to get long-distance connection with Chicago, Ill., as the result of a deal between President Albert G. Wheeler, of the Illinois Tunnel Company, and the Interstate Telephone Association.

Mr. Wheeler has promised the use of the tunnel for telephone wires and connections with the new Chicago automatic telephone exchange. The deal is of great importance to Independent telephone interests.

Proposition to Divide Service.

A special meeting of the Orange & Sussex Independent Telephone Assocation was lately held in Middletown, N. Y., to discuss the proposition made by the Hudson River Telephone Company, whereby it gives to the Orange County the local service in return for the toll line service to out of town points. The sentiment of the meeting seemed to be against the proposal, one of the points being taken that the other companies in the Orange-Sussex Company would be deprived of the Middletown toll service.

The proposition from the Hudson River Company to the Orange County Company, while it has been presented to the directors, has not yet been before the stockholders. The directors and stockholders are divided over the matter.

President Alonzo Burt, of the Wisconsin Telephone Company, has resigned as president of the Missouri & Kansas Telephone Company, which controls the Bell interests in Missouri, Kansas and Oklahoma, and official announcement has been made that Mr. Burt will arrive in Milwaukee on January 1, to take charge of the Wisconsin Company.

On January 4, the Maryland Telephone Company will open its connections with its lines West, and will have a through service as far west as St. Louis and Chicago. Mayor Timanus will send the first official message over the lines from Baltimore, and will converse with the mayors of St. Louis and Chicago.

The telephone service in Cordele, Ga., is being extended through the country districts. The charges will be no more than that charged in every similar section of the country districts, and the service rendered will be much improved, because of the new switchboard being installed in the exchange at Cordele.

The People's Home Telephone Company is making a number of extensions and improvements in Bessemer, Ala., which will greatly increase the telephone facilities and give service to sections of the city which have not had it before.

J. W. Moore & Son have bought out the Pendleton, Tex., Telephone Company, and will shortly put up lines along the various public roads.

The lines of the Odell and the Blue Springs Neb., Telephone Companies have been connected up, and regular service commenced.

Michigan State Meeting Will be Held January 10.

W. C. McMillan, a director and stockholder of the Michigan State Telephone Company, and W. A. Jackson, president of the company, have been East, where they conferred with interests identified with the company, prior to the annual meeting of stockholders, to be held in Detroit January 10. It is understood that some interesting figures as to the progress of the company during the year will be submitted at the meeting.

Railroad Officials Sanction Use of Telephones.

A committee of officials connected with the telegraph department of the Baltimore & Ohio Railroad has prepared rules authorizing the use of telephone service as an auxiliary to the telegraph system and in directing the movement of trains on the road. The arrangement is designed to regulate officially the use of the telephone by operators along the road when the telegraph service is disabled and it is impossible to communicate by that means. For years the operators have been using the telephone as a last resort in emergency and with good results, but had no system or official sanction.

The committee spent several days in Baltimore preparing the rules for the use of the telephone, and if approved by General Manager Sims they will be put into effect where connections are made with telephone lines.

Mr. Charles Selden, superintendent of telegraph of the Baltimore & Ohio, was chairman of the committee, and the other members of the committee were Mr. Edward W. Day, assistant superintendent, and eight division chief operators.

For 11 months the Keystone Telephone Company of Philadelphia, Pa., has earned net \$320,130, against \$203,197 for the same period of 1903. The company is earning about 7 per cent. on the cost of building the plant, which was nearly or quite \$5,000,000. It is said that the Keystone is now earning gross about one-quarter as much as the Bell in Philadelphia.

The Central Union Telephone Company is to make a change in the service it is furnishing to Decatur, Ill. It is to do away with 10-party line business and residence; and as far as it can will do away with four-party lines. The aim is to confine the service to two-party and Independent lines. No new subscriber will be taken on for more than a two-party line.

It is rumored that Ruston, La., is soon to have an Independent telephone system. Cap italists have been looking over the ground preparatory to asking for a franchise. The present telephone service does not seem to meet the demands of the people, and a number of prominent citizens are said to be interesting themselves in the new movement.

The Vidalia, Ga., Telephone Company, with L. R. King, as manager, will soon be ready to serve the business men and residents of Vidalia. The very latest and best 'phones are being used, and everything is being arranged in first-class order.

Convention Date Set for Northwestern Independent Men.

The annual convention of the Independent telephone men of the Northwest will be held in Sioux Falls, S. D., January 11 and 12, 1905. The territory covered by the Independent wires, is all of South Dakota east of the Missouri River, Southwestern Minnesota and Nothwestern Iowa. An interesting programme has been prepared and a large attendance is expected.

Extending Its Wires.

At a recent meeting in the executive offices of the Home Telephone Company's building in Kansas City, Mo., plans were formulated for the additional extension of long-distance telephone wires into different sections. E. L. Barber, of Wauseon, O., president of the Western Independent Telephone Company; Lee Benoist, representing the Commonwealth Security Company of St. Louis; J. J. Heim, O. C. Snider and Hugh C. Ward, of the Home Telephone Company, were present.

The extension now under way of the long-distance service of the two companies represented at the meeting from Ottawa, Kan., to Independence, Coffeyville, Chanute and other points in the oil and gas belt of Kansas, was reported to be progressing satisfactorily and it is expected it will be completely finished by early spring, at a cost of \$200,000.

Other plans contemplated of connecting up with long-distance service in the East and Southeast were discussed and it was stated that a movement to cover the entire Middle West with a complete service was being crystallized.

A new telephone line is being extended south of Danbury, Ia., and steps have been taken towards the construction of another north and east. The rapid extension of new lines is making Danbury one of the largest and most important exchanges of the Maple Valley system.

The Christian County Telephone Company of Missouri, will consider the question of increasing its capital stock from \$6,000 to \$15,000 at a meeting to be held January 3.

The New England Telephone Company is looking about Portsmouth, N. H., for a suitable site for an office building which it will erect there.

The Iowa Telephone Company, of Waterloo, now has three miles of underground telephone lines to its credit.

A telephone line is to be constructed between Tesla and Livermore, Cal.

Telephone Incorporations.

The Liberty Telephone Company, Liberty, Ind. Capital stock, \$20,000. Incorporators included about 50 citizens of Liberty.

The Amboy Telephone Company, Amboy, Ind. Capital stock, \$20,000. Directors: N. W. King, Willam Myers, B. F. Miller, Noah Shrock and A. D. Hensler.

The Mutual Telephone Company, Kirwin, Kan. Capital stock, \$1,500.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albany, N. Y.—The Manhattan & Bronx Electric Company has been incorporated with a capital of $10,000 to furnish electricity for all purposes throughout the boroughs of New York. The directors are Willis B. Richards, of New Rochelle, and John S. Clark and James B. Stafford, of Brooklyn.

Alma, Neb.—This place is to have an electric light plant and waterworks.

Arcanum, O.—The city council is to be petitioned for the issuance of $35,000 in bonds for the construction of waterworks and an electric light plant. An election will probably be called.

Bangor, N.Y.—The city council has created a committee to consider the question of the advisability of taking such action in the council and securing such action by the State Legislature as may be necessary to empower this city to generate and sell electric light, power and heat to the residents of Bangor and vicinity.

Camilla, Ga.—This city has engaged Ludwig & Co., of Atlanta, to draw plans and supervise the construction of an electric light plant and waterworks, for which $18,000 of bonds were recently voted.

Christiansburg, Va.—This city contemplates making a change in the operation of the electric light plant, and bids on the franchise will be received until January 5. Address W. C. Flagg, mayor.

Coalgate, I. T,—A 20 year franchise to erect and operate an electric light plant in this city has been given to the Coalgate Company.

Cookeville, Tenn.—The citizens will soon vote on a proposition of issuing bonds to the amount of $25,000 for the erection of an electric light plant, waterworks system and street improvements.

Columbia, Ky.—This city is soon to have electric lights. Myers Brothers have purchased the franchise, and operations on the plant will commence at an early date.

Crawford, Ga.—The citizens have decided to light this city with arc lights.

Creston, Ia.—A special election will be held here in January to vote on a franchise asked for by the electric light and gas company.

Crewe, Va.—This town contemplates expending $1,000 in installing a system of electric lights. The town clerk can be addressed.

Douglas, Ga.—Messrs. Joseph S. Walker, president of the Electric Supply Company of Savannah, and H. F. Cameron, of the Westinghouse Electric Company, and Electrician C. J. O'Farrell, are negotiating for the erection of an electric light plant here.

England, Ark.—This city will construct an electric light plant. T. J. Hudson, mayor.

Forest, Miss.—Local parties will organize a company and erect a cotton compress, oil mill, ice plant and electric light plant. G. A. McIlhenny, president of the Business Men's League, can be addressed.

Golden, Ill.—George Beckett wants to put in an electric light plant for about $6,000 to $8,000 to light the whole town. He has placed the matter before the board of trustees.

Grey Eagle, Minn.—This city is to have an electric light plant.

Jellico, Tenn.—The Jellico Electric Light, Heat & Power Company has decided to increase its plant and install new machinery.

Kansas City, Mo.—In the upper house of the council an ordinance was introduced appropriating $4,000 to buy a new dynamo for the city hall lighting plant; the matter was referred to the finance committee.

Leadville, Col.—Major George B. Burbank and George Stuart Simons, of New York City, A. S. Harvey, of this city, and Philadelphia capitalists are interested in a project to establish a great electric light and power plant at the Malinaltango Falls, near the City of Mexico. About 25,000 hp. will be generated.

Martinsville, Va.—At a recent election held here, it was decided to vote a $60,000 bond issue on the town for the purpose of erecting an electric light plant.

Murphy, N. C.—The Murphy Electric Light & Power Company has been chartered with $6,000 capital by J. Gentry.

Philadelphia, Pa.—The Philadelphia Electric Light Company is the only bidder for the electric lighting of the streets for 1905.

Reardan, Wash.—The city council has granted a 15 year franchise to J. M. McDowell for an electric light plant. Mr. McDowell will install a 100 hp. boiler and engine and two dynamos that will carry 1,500 lights.

Russellville, Ark.—Dr. H. B. Smith and a number of other prominent business men have purchased the electric light plant, which was controlled by Smallwood & Sons.

Sedalia, Mo.—W. H. Powell and L. P. Andrews, of this city, and others, are the directors of the Sedalia Transit Company, which has been organized with a capital stock of $60,000, to absorb the Railway & Electric Company here, and erect and operate an electric lighting and street railway plant.

Ukiah, Cal.—The city trustees have granted W. Van Arsdale a contract for furnishing this city with electric power. Mr. Van Arsdale is the owner of the Walker Valley Ranch and will at once commence the erection of an electric light plant.

Wiggins, Miss.—This city has granted a franchise to the Wiggins Electric Light & Power Company, to construct and operate an electric light plant.

STREET RAILWAYS.

Alton, Ill.—This city and East St. Louis are to be connected by an electric railway.

Boone, Ia.—There will be an electric line from this city to Fraser.

Canisteo, N. Y.—The board of trustees of this place has granted to Lester D. Whiting a franchise for the building of an electric surface railway, and electric light plant for heating and lighting purposes.

Columbus, Wis.—An electric line will be run between this city and Lake Geneva. The company has a capital of $25,000.

Greenville, Pa.—A trolley line will be constructed from this city to West Middlesex.

Kenosha, Wis.—A company is being organized here for the building of the proposed electric railway from this city to Lake Geneva. It is to have a capital of $25,000.

Minneapolis, Minn.—Indiana capitalists in connection with the Twin City Rapid Transit Company will build a trolley line from St. Paul and this city to Faribault, Minn.

Petersburg, Mich.—Preparations are being made for the erection of a new power house for the Toledo & Jackson electric road.

St. Louis, Mo.—A new traction line is projected between Mitchell and Edwardsville, Ill. The line is being franchised by F. E. Allen, of this city, who says it will be completed by July.

West Newton, Pa.—The Donora, Webster & West Newton Street Railway Company is preparing to carry out its plans of constructing a trolley line connecting the three towns named. With this object in view, the company has purchased rights of way from a number of landowners.

POWER PLANTS.

Danbury, Conn.—The Danbury Power Company has petitioned the General Assembly for a charter to establish a power plant on the Still River at Brookfield and New Milford, and to transmit electricity from the plant to this city, Bethel, Brookfield, Ridgefield and Redding. The men making the petition are Charles H. Merritt, S. C. Holley, M. H. Griffing, B. A. Hough and A. N. Wildman.

Grove City, Pa.—It has been voted by this city to issue bonds to the amount of $12,000 for building an additional power plant and extending the system.

BIDS WANTED.

Ashboro, N. C.—The Ashboro Copper Mining Company, Limited, will shortly be in the market for an 80 hp. engine and boiler of equal capacity.

Bay City, Mich.—Sealed bids will be received until January 3 for the construction of an electric light plant for this city, in accordance with plans at the office of the comptroller of the city board of public works, of which T. W. Moore is secretary.

Columbia, S. C.—Charles C. Wilson, of this city, wants prices on dynamos, arc lamps, etc.

Little Rock, Ark.—The Arkansas Brick & Manufacturing Company of this city is in the market for a new or second-hand 25 hp. engine, Corliss, or automatic.

Nashville, Tenn.—The Nashville Bridge Company is in the market for punches, shears, cold cut rolls, lathes and air-compressors, all electrically driven.

Tampa, Fla.—W. H. Brown, care of the Almeria Hotel, of this city, is in the market for a 25 hp, engine, and a 40 or 50 hp. boiler; good second-hand preferred.

Washington, D. C.—Sealed proposals are being invited by the Bureau of Supplies and Accounts until January 10, for furnishing the New York, Boston, Washington, League Island and other Navy Yards, with a quantity of motors, arc lamps, panel boards, switches, circuit breakers, tape, mica, battery cells and boxes, wire and miscellaneous electrical supplies. Specifications and blank proposals can be obtained upon application to the Bureau or to the Navy pay offices in the cities mentioned.

Webb City, Mo.—Harry Tamblin, care of the Corrie Coal Mining Company of this city, is in the market for a 125 hp. boiler.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 14¾@15c.; Lake 14⅞@15⅛c.; casting, 14½@14¾c.

The Electric Storage Battery Company has declared the usual dividend of 1¼ per cent., payable January 2.

A Philadelphia Electric authority says that no deal with the Keystone Telephone Company has yet gone through.

Thomas J. Maloney has been elected president of the newly organized North Jersey Electric Heat, Light & Power Company.

The Consolidated Traction Company of New Jersey has declared a dividend on the stock of 1½ per cent., payable January 15 as registered December 30.

By the proposed plan of reorganization of the New Orleans Railways Company it is said that the principal stockholders of the company will lose close to $20,000,000.

The Bell Telephone Company of Philadelphia has declared the regular quarterly dividend of 1½ per cent., payable January 18. Books close January 5.

At a recent meeting of the creditors and shareholders of the Hiram Maxim Electrical Engineering Company of London it was stated that the present difficulties of the company were due to want of capital.

The Chicago Union Traction Company, according to Judge Grosscup's latest order, must raise about $400,000 by January 1, for the use of the receivers, in payment of interest and rentals, or be adjudged in default on its leases.

Directors of the American Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent. and ¾ per cent. extra. The dividend is payable January 16 to stock of record December 31.

At the annual meeting of the stockholders of the Massachusetts Electric Companies the following trustees were reelected for a term of three years: Gordon Abbott, Reginald Foster, Alexander Cochrane, Stillman F. Kelley and Walter Hunnewell.

The Appellate Division of the New York Supreme Court handed down a decision compelling the Board of Railroad Commissioners to grant permission to the New York City Interborough Railway Company to construct six lines of electric roads in the Bronx.

Authority to go into the business of manufacturing and selling gas and electricity for light, heat and power to private customers is to be given the Chicago City Council by the new charter, if the ideas of the Committee on State Legislation are carried out by the Legislature.

The fiscal year of the General Electric Company ends with the close of next month, and it is claimed that it will be shown that the reserve fund has increased to about $12,000,000, and that the company has now a hidden reserve in its property and securities accounts of about $18,000,000.

The chartering of scores of new traction companies almost every week is one of the prominent developments of the year. Recently five of these corporations were chartered at Harrisburg, Pa., in one day. Literally hundreds of them are getting out charters in every part of the country.

Redmond & Co. of New York are offering to investors $250,000 Louisville Lighting Company's first mortgage 5 per cent. 50-year gold bonds, interest payable April and October 1. The offering price is par and accrued interest. The bonds are a first and only lien on the entire property of the company now owned or that may be hereafter acquired.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Dec. 27.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	163¼
Metropolitan Street Railway	120
Metropolitan Securities	79
Ninth Avenue	197
Third Avenue	132
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	60¾
Public Service Corporation (New Jersey)	135
Philadelphia.	
Consolidated Traction of New Jersey	77¼
Philadelphia Traction	98½
Union Traction	59⅛
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	14
do. do. do. pref.	62
West End Street, com	92¼
do. do. do. pref.	113
Chicago.	
City Railway	186
North Chicago	87½
Union Traction, com	10
do. do. pref.	41
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17
do. pref.	62
Electric Boat, com	40
do. do. pref.	70
Electric Lead Reduction	½
Electric Vehicle, com	17
do. do. pref.	23
Westinghouse, com	184½
do. pref.	195
General Electric	186
Boston.	
Edison Electric Illuminating	254
General Electric	186
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	43
do. do. pref.	109
Philadelphia.	
Electric Company of America	10
Electric Storage Battery, com	79
do. do. do. pref.	79
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	146
Western Telephone Company	20
New England Telephone Company	137
New York.	
American Telegraph & Cable Company	93½
Commercial Cable Company	210¼
Mexican Telephone Company	2
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94
Miscellaneous.	
Chicago Telephone Company	144¾
Tel., Tel. & Cable Company of America	..
MISCELLANEOUS STOCKS.	
Otis Elevator Company	47
Consolidated Car Heating	64
Standard Underground Cable	200

POSITIONS VACANT.

FREE ADVERTISING.

Inquiries from those seeking employment as Electrical Engineers, Superintendents, Foremen, Salesmen, Dynamo-tenders, Constructing and Designing Engineers, Electro-metallurgists, or in other positions requiring technical experience or intimate acquaintance with the electrical trade, will be inserted in this column Without Charge. Each advertiser is invited to repeat his advertisement in case the first one produces no results.

It is the desire of the management of this paper to bring the unemployed and employer together to their mutual benefit, and to this end they invite the former to make use of this column without charge. No advertisement exceeding five lines (about 35 words) will be inserted, but advertisers may write fully of their qualifications and these letters will be kept on file for future reference in filling vacancies which may occur.

Applicants should write clearly and distinctly and enclose postage to secure attention.

Address all communications to Free Advertising Editor, "Electricity," New York.

SITUATIONS WANTED.

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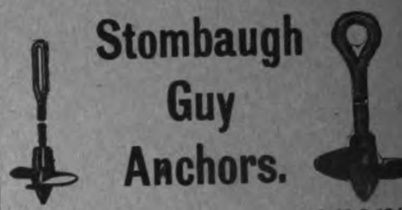

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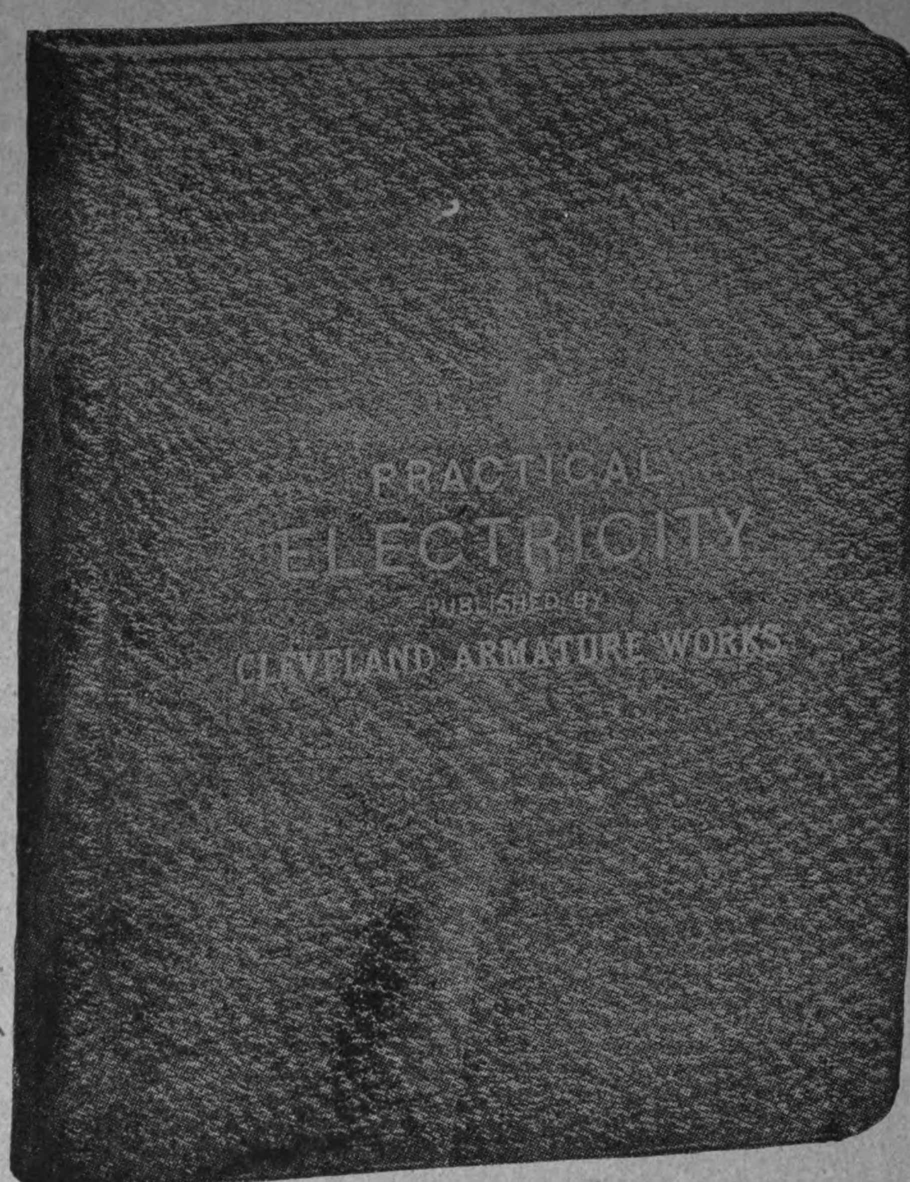

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